

U. S. CIRCUIT COURT. EASTERN DISTRICT OF
PENNSYLVANIA

American Graphophone Company	)	In Equity
versus	)	Oct. Session
Berliner Gramophone Company,	)	1898
Thomas S. Parvin, and E.	)	No. 34
R. Johnson	)	

are that it will not for an indefinite period. Mr. Welte, in talking about these instruments, said that their popularity seemed to be increasing all the time. "Why, it has become quite a fad to have them in private residences, and in the past five months we have placed at least seven of them there.

"As a general thing, when we receive an order for one of our pneumatic orchestrions, which is to be placed in a private residence, the design for the case work is drawn by an artist, the owner wishing to have figures and other fancy work, which will make the appearance of the instrument very ornamental and artistic. "This," said Mr. Welte, "was the case with the instrument that we very recently placed in Claus Spreckels, the sugar king's mansion in San Francisco, which is unquestionably one of the handsomest, if not the handsomest, ever constructed by us. Then, again," continued Mr. Welte, "we have to be up to date in supplying music for these instruments, and on our books we have standing orders for any new piece of music that we get out," and with that the writer was shown a new lot just received from their factory, where it is cut and arranged for the orchestrion, consisting of waltzes, marches, selections from comic operas, etc. These were all ready to be sent to different people who had the M. Welte & Sons' famous pneumatic orchestrions.

J. B. FURBER IN THE WEST.

J. B. Furber, of the Regina Music Box Co., left last Saturday on an extended Western trip which will keep him away three weeks. He will visit all the principal cities in the West, going as far as Kansas City. Mr. Furber is taking this trip for the purpose of calling on the different houses that handle the Regina boxes and to pick up any new business that may come his way. I was told at the Regina warerooms that their business during the holidays had been exceptionally good, and that last year showed a marked improvement over the previous year in the way of sales of the Regina boxes.

WORKING NIGHT AND DAY.

[Special to THE MUSIC TRADES.]

GRAND RAPIDS, Dec. 28, 1901.

The firm of J. W. York & Sons are having a big rush of business and, in consequence, are running night and day so that they can fill their orders. The unusual amount of business the firm is having to look after was in evidence to your correspondent to-day, when he called at the office and found that the firm have added another typewriter to the present force of operators.

DANROF.

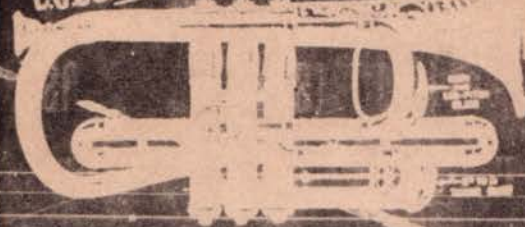
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M. E. SCHOENING,

Sole Selling Agent for
American and European Manufacturers in
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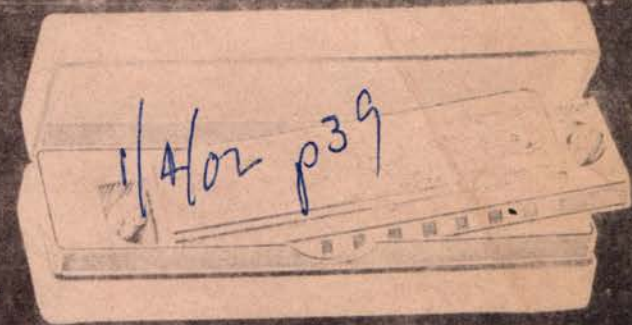
For Standard Brands of
Musical Merchandise refer to

"PIANO AND ORGAN PURCHASER'S GUIDE."

have come to this country," said Mr. Schoening, "but from what I could learn there must have been quite a large number; but I hope that I have been the means of putting a stop to it, and, as I said before, I hope that all dealers in ordering these strings will correspond with the manufacturer or myself."

FRIEDRICH HOTZ' CHALLENGE HARMONICA.

Friedrich Hotz, of Knittlingen, in Wurtemberg, is known as one of the oldest and most reliable of first-class harmonica manufacturers. His goods are known all over the world and for clear, far-carrying tone, correctness



FRIEDRICH HOTZ' CHALLENGE HARMONICA.

in tuning and durability, they are second to none. The Challenge harmonicas of Friedrich Hotz are so named because he challenges any and all makers to produce an instrument "equal to these." These harmonicas have bell metal reeds, made by a new process, and they are the most responsive and sensitive of any reed ever invented. They are most durable and have a clear, full, sonorous, far-carrying bell tone. The cut represents the famous No. 217 open-back harmonica and, like all of the Challenge harmonicas, come in fancy gilt-letter hinge boxes. A trial will convince the trade and the profession that the achievement in harmonicas has been reached in the Friedrich Hotz Challenge. So says M. E. Schoening, of No. 369 Broadway, New York, who handles them in this country.

GRAPHOPHONES AND GRAMOPHONES PLAYED IN COURT.

In the United States Circuit Court, Philadelphia, last week, numerous graphophones and gramophones were brought into the court-room before Judge McPherson during the argument in an equity suit instituted by the American Graphophone Co. against the Berliner Gramophone Co. and others, to restrain the defendants from making an alleged infringement on a patent for talking-machines, claimed to be the exclusive property of the complainant. The defendant asserted that the machine was constructed under a patent entirely different from that of the complainant's; counsel gave exhibitions of the workings of their machines, rendering selections from popular music. Decision was reserved.

HAS INVENTED A NEW INSTRUMENT.

Louis K. Keinhof, of Milwaukee, a musical instructor, has invented a musical instrument which he believes will eventually take the place of the mandolin and the zither. It is a combination of both instruments, and combines the soft tones of the zither with the stronger notes of the mandolin. It has six double strings and is intended to be played while resting on a table. Mr. Keinhof has applied for a patent, and is manufacturing the instrument at his establishment in Milwaukee, Wis.



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Record Group No. 21

U.S. Circuit Court
Eastern District of Pennsylvania
October 1898
Equity No. 34

No. 34.

October Sessions, 1898.

IN THE

Circuit Court of the United States,

EASTERN DISTRICT OF PENNSYLVANIA.

IN EQUITY.

AMERICAN GRAPHOPHONE COMPANY,

Complainant.

v.

BERLINER GRAMOPHONE COMPANY, THOMAS S.

PARVIN, and E. R. JOHNSON,

Defendants.

Defendants' Record.

HORACE PETTIT,

Solicitor and of Counsel for Defendants.

604 Stephen Girard Building,
Philadelphia, Pa.

*Filed
Nov 8-1901.
Samuel Bell
clerk*

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2. 38,823, June 9, 1863, Hayden, Rose Engine.	89
3. 200,521, February 19, 1878, Edison, Phonograph or Speak- ing Machines	90
4. 213,554, March 25, 1879, Edison, Automatic Telegraph.	90

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5. 219,939, September 23, 1879, Hall Phonograph	90
6. 227,679, May 18, 1880, Edison, Phonograph	90
7. 283,665, August 21, 1883, Rogers, Automatic Telegraph .	90
8. 387,166, October 23, 1883, Reynolds, Phonograph . . .	90
9. 534,543, February 19, 1895, Berliner, Gramophone . . .	90
10. 548,623, October 29, 1895, Berliner Sound Record and Method of Making same	90

BRITISH PATENTS.

11. No. 1,644, A.D., 1878, April 24, Edison, Recording and Reproducing Sounds	90
12. No. 6,927, A.D., 1886, (Star) to Johnson as amended October 7, 1890, and the proceedings for the amend- ment thereof	90

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13. No. 124,213, May 15, 1888, delivered July 27, 1878, to Cros, for New Methods in Phonography, translated .	90
14. Certificate of addition to Cros Patent, No. 124,213, taken August 3, 1878, translated.	90

PUBLICATIONS, ETC.

15. Comptes Rendus de L'Academie des Sciences of December, 1877, pp. 1082 and 1083, translated	90
16. Lehrbuch de Physik und Meteorologie by Muller Pouillet Braunschweig Edition of A.D., 1868, Vol. 2, p. 252, Figures 253 and 254, translated	90
17. Poggendorff's Annalen der Physik und Chemie published at Leipsic, A.D., 1843, Volume 59, plate 1, Figure 1, 2 and 3. P, by Jacobi, translated	90
18. The Telegraphic Journal, Vol. 7, p. 53, published at Lon- don, February 1, 1879, on the Carbonel Phonograph .	90

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IN THE
Circuit Court of the United States,
EASTERN DISTRICT OF PENNSYLVANIA.

October Sessions, 1898. No. 34.

IN EQUITY.

AMERICAN GRAPHOPHONE COMPANY,
Complainant,

vs.

BERLINER GRAMOPHONE COMPANY, THOMAS
S. PARVIN, AND E. R. JOHNSON,
Defendants.

The Answer of the Berliner Gramophone Company, a corporation organized and existing under the laws of the State of West Virginia, having its principal place of business in the City of Philadelphia, State of Pennsylvania, one of the above-named defendants, to the Bill of Complaint of the American Graphophone Company, the above named complainant.

This respondent now and at all times hereafter saving and reserving to itself any and all manner of benefit or advantage of exceptions, or otherwise, that can or may be had to the many errors, uncertainties and imperfections in the said Bill of Complaint contained, for answer to said bill, or so much thereof as the defendant is advised is material or necessary for it to make answer unto, answering says;

Whether the said complainant, the American Graphophone Company, is a corporation duly organized and existing

D 78

under the laws of the State of West Virginia this defendant does not know save by information contained in said Bill of Complaint, and calls upon said complainant for proof thereof.

1. This defendant denies that Chichester A. Bell and Sumner Tainter were the original, first or joint inventors of the alleged improvements in recording and reproducing speech and other sounds referred to in paragraph 1 of the Bill of Complaint, and denies that the same were not known or used by others in this country before the date of their alleged invention by the said Bell and Tainter, and denies that they were not patented or described in any printed publication in this or any foreign country before the invention of the said Bell and Tainter, and denies that they were not in public use or on sale in the United States for more than two years prior to the date of the application of the said Bell and Tainter for a patent therefor, and denies that the same had not been abandoned to the public.

2. This defendant believes and admits that certain Letters Patent of the United States No. 341,214, dated May 4, 1886, were issued to the said Chichester A. Bell and Sumner Tainter for certain alleged improvements in Recording and Reproducing Speech and other Sound, but denies that the said Bell and Tainter in making application therefor complied in all respects with the provisions and requirements of the laws of the United States in such case made and provided; and denies that any valid exclusive rights were acquired by virtue of the issue of the said Letters Patent.

3. This defendant denies that the said Sumner Tainter was the original, first and sole inventor of the alleged improvement in Apparatus for Recording and Reproducing Sounds or Sonorous Vibrations, as averred in paragraph 3 of the Bill of Complaint, and denies that the said alleged invention was not known or used by others in this country, or patented or described in any printed publication in this or any foreign country prior to the date of the alleged invention of the said Tainter, and denies that the same was not in public use or on

sale in the United States for more than two years prior to the application for Letters Patent therefor; and denies that the same has not been abandoned to the public.

4. This defendant believes and admits that certain Letters Patent of the United States, No. 341,288, dated May 4, 1886, were issued to the said Sumner Tainter for certain alleged Improvement in Recording and Reproducing Sound, but denies that the said Tainter in making application therefor fully complied with the provisions and requirements of the laws of the United States in such made and provided; and denies that any valid, exclusive rights were acquired by the virtue of the issue of said Letters Patent.

5. This defendant denies that the said Charles Sumner Tainter was the original, sole and first inventor of the alleged Improvement in Apparatus for Recording and Reproducing Speech and other Sound referred to in paragraph 5 of the Bill of Complaint; and denies that the said invention was not known and used by others in this country, or patented or described in any printed publication, in this or any foreign country before the date of the alleged invention of the said Tainter, and denies that the same was not in public use or on sale in the United States for more than two years prior to the date of the application for the said Letters Patent; and denies that the same was not abandoned to the public.

6. This defendant believes and admits that certain Letters Patent of the United States, No. 375,579, dated December 27, 1887, were issued to the said Charles Sumner Tainter for certain alleged Improvements in Apparatus for Recording and Reproducing Speech and other Sounds, but denies that the said Charles Sumner Tainter in making application therefor fully complied with the requirements and provisions of the laws of the United States in such case made and provided, and denies that any valid exclusive rights were acquired by virtue of the issue of said Letters Patent.

7. This defendant denies that the said alleged inventions and improvements described in the said Letters Patent No. 341,214, No. 341,288 and No. 375,579, were designed for or are capable of conjoint use in the legal sense of the term, and denies that they are thus conjointly used by defendants.

8. This defendant does not know and has no information, save by said Bill of Complaint, whether said Letters Patent No. 341,214 were assigned by the said Bell and Tainter to the Volta Graphophone Company, as alleged in paragraph 8 of the Bill of Complaint, and calls upon the complainant for proof thereof.

9. This defendant does not know and has no information, save by said Bill of Complaint, whether said Letters Patent No. 341,288, were duly assigned by the said Sumner Tainter to the said Volta Graphophone Company, and calls upon the complainant for proof thereof.

10. This defendant does not know and has no information, save by said Bill of Complaint, whether said Letters Patent No. 375,579, were duly assigned by the said Charles Sumner Tainter to the said Volta Graphophone Company, and calls upon the complainant for proof thereof.

11. This defendant does not know and has no information, save by said Bill of Complaint, whether said Letters Patent No. 341,214, No. 341,288 and No. 375,579, or any of them, were duly assigned unto the complainant, the American Graphophone Company, by the said Volta Graphophone Company, and calls upon the complainant for proof thereof.

12. This defendant denies that it has ever made, sold or used, directly or indirectly, any constructions or devices which infringe any of the claims of any of the said Letters Patent hereinbefore referred to; and denies that the complainant is now, or ever was, the sole and exclusive owner of any rights acquired under or by virtue of the said Letters Patent, or otherwise, which this defendant has infringed.

13. This defendant denies that the complainant has expended large sums of money in practicing and introducing to the public any invention or improvement which this defendant has made, sold or used, directly or indirectly, and denies that there has been any public acquiescence that Bell and Tainter were the first original inventors of the devices and constructions which the complainants by the said Bill of Complaint claim broadly were the inventions of the said Bell and Tainter, and denies that the said patents are good and valid patents; and this defendant denies that the public have acknowledged these claims of the complainant to the exclusive right to the said alleged inventions under the said patents; and this defendant denies that it has done or performed any acts, directly or indirectly, which have infringed or interfered with any rights of the complainant in the premises.

14. This defendant is informed and believes that the said complainant did file a Bill of Complaint in the United States Circuit Court for the Southern District of New York, to enjoin the manufacture, use and sale of a machine known as the "Metaphone," and that the Court, in a decision by Judge SHIPMAN (87 Fed. Rep., 873), held that the said "Metaphone," as an organized whole, infringed claims 19 to 24 of Letters Patent No. 841,214; but this defendant avers that the said "Metaphone" embodies a construction and combination relative to the said claims which is absolutely and totally dissimilar from the construction and operation of any machine or device which this defendant has made, used or sold, directly or indirectly, and it is informed and believes that the decision of Judge SHIPMAN relative to the said "Metaphone" has no application whatsoever to any device that this defendant has ever made, used or sold; and this defendant is informed and believes that the construction given by Judge SHIPMAN to the said claims would positively preclude their application to any device or combination of parts which this defendant may have at any time made, sold or used.

15. This defendant denies that the said E. R. Johnson, or others acting in concert with him, has made or caused to be made, for the said Berliner Gramophone Company, or for any of these defendants, or sold to them or any of them, apparatus or parts of apparatus adapted or intended to be used for recording and reproducing speech, or other sounds, substantially as described and claimed in said Letters Patent No. 341,214, No. 341,288 or No. 375,579; and denies that the said Johnson has sold or delivered to the said Berliner Gramophone Company, or to the said Parvin, at any time, any devices such as described and claimed in any of the said letters patent, or any parts of such devices for any purpose whatsoever. This defendant denies that the said Berliner Gramophone Company, or the said Parvin, has assembled or employed any parts received from the said Johnson, or from any other source, which form any apparatus whatsoever embodying the construction claimed in any of the said letters patent; and denies that it has in any manner infringed any of the said letters patent, or has done any acts whatsoever with the intent to injure the complainant, or deprived it of any just profits to which it may be entitled, from or arising out of the said patents in suit, or any of them.

This defendant denies that it has conspired or concerted with any party or parties in any infringement of, or in any attempt to infringe, directly or indirectly, any of the rights of this complainant under or by virtue of the said letters patent in suit, or any of them; and denies that it has threatened individually, or in concert with others, directly or indirectly to so infringe any of the rights of this complainant in the premises; and denies that the complainant, by any acts of this defendant, or any acts of these defendants, has suffered any irreparable loss or injury, or any loss or injury whatsoever; and denies that this complainant has by any unlawful act of this defendant, or any of these defendants, been deprived of any gains or profits whatsoever; and this defendant denies that it, or any of the said defendants, have ever received or derived, or are receiving or deriving any gains or profits whatsoever by reason of any infringement of the rights of the complainant in the premises, or otherwise.

16. This defendant denies that it has by any acts whatsoever encouraged or induced others to infringe the said Letters Patent in suit, or any of them.

17. This defendant denies that it was duly notified by complainant of the alleged infringement complained of in said Bill of Complaint, and denies that it refused to desist from any infringement of any rights of the complainant in the premises.

This defendant avers that the complainant has wholly failed to comply with the requirements of Section 4909 of the Revised Statutes of the United States, in that it has wholly failed to give public notice of the fact of the issue of the said respective Letters Patent, or of the number or date of the same of any claim it had, or pretended to have had, or to have, to the exclusive use of the said respective alleged inventions by virtue of the said respective Letters Patent in suit, or otherwise, by marking, stamping, or otherwise affixing notice to the said respective alleged patented improvement, in suit as made, sold or used by the complainant; but that it has failed to mark the said alleged patented improvements, as required by said Section of the Revised Statutes.

This defendant, further answering, and not waiving any, but insisting upon all and singular the matters herein set forth, further says by way of defense to the said Bill of Complaint, upon information and belief, that the said Letters Patent in suit, and each of them, are null and void, for the reasons as follows, to wit:

18. That the said Chichester A. Bell and Sumner Tainter, the alleged joint inventors of the alleged Improvements in **Recording and Reproducing Speech and other Sounds, described and claimed** in said Letters Patent No. 341,214, were not the true, original or first inventors or discoverers, or joint inventors or discoverers, of the said alleged Improvement described in the said Letters Patent, nor of any material or substantial part thereof, but that the thing patented in the said Letters Patent No. 341,214 was prior to the alleged invention or discovery of the said Bell and Tainter known to

and used by the hereinafter mentioned persons at the hereinafter mentioned places, respectively.

That the said Sumner Tainter, the alleged inventor of the Apparatus for Recording and Reproducing Sounds, described and claimed in Letters Patent No. 341,288, was not the true, original or first inventor or discoverer of the said alleged improvement described and claimed in said Letters Patent, nor of any material or substantial part thereof, but that the thing patented in the said Letters Patent No. 341,288 was prior to the alleged invention or discovery of the said Tainter, known to and used by the hereinafter mentioned persons at the hereinafter mentioned places, respectively.

That the said Charles Sumner Tainter, the alleged inventor of the Apparatus for Recording and Reproducing Speech and other Sounds, described and claimed in the said Letters Patent, No. 375,579, was not the true, original or first inventor, or discoverer, of the said alleged Improvement described and claimed in said Letters Patent, nor of any material or substantial part thereof, but that the thing patented in the said Letters Patent, No. 375,579, was prior to the alleged invention or discovery of the said Charles Sumner Tainter known to and used by the hereinafter mentioned persons at the hereinafter mentioned places, respectively, to wit:

Thomas A. Edison, of Llewellyn Park, New Jersey, at Menlo Park, New Jersey, and elsewhere.

Emile Berliner, of Washington, D. C., at Washington, D. C., and elsewhere.

John F. Ott, of Orange, New Jersey, at Menlo Park, Orange, New Jersey, and elsewhere.

Edward H. Johnson, of Greenwich, Connecticut, at Menlo Park, New Jersey, New York, New York, and elsewhere.

Charles Batchelor, of New York, New York, at Menlo Park, New Jersey, New York, New York, and elsewhere.

John Kruesi, Schenectady, New York, at Menlo Park, New Jersey, New York, New York, and elsewhere.

James U. McKenzie, of Brooklyn, New York, at Menlo Park, New Jersey, New York, New York, and elsewhere.

George H. Harrington, of Wichita, Kansas, at Wichita, Kansas, and elsewhere.

Frank Lambert, of Brooklyn, New York, at Ansonia, Connecticut, Jamaica, Brooklyn, and New York, New York, and elsewhere.

Eugene Pastre, of Brooklyn, New York, at Ansonia, Connecticut, at Jamaica, Brooklyn, and New York, New York, and elsewhere.

Walter D. Davis, of Brooklyn, New York, at Ansonia, Connecticut, Jamaica, Brooklyn, and New York, New York, and elsewhere.

Isaac W. Heysinger, of Philadelphia, Pennsylvania, at Philadelphia, Pennsylvania, and elsewhere.

Ansonia Clock Co., of Ansonia, Connecticut, at Ansonia, Connecticut, and elsewhere.

Clarence J. Blake, of Boston, Massachusetts, at Boston, Massachusetts, Washington, D. C., and elsewhere.

Clarence E. Gifford, of Jamestown, New York, at Jamestown, New York, Chicago, Illinois, Lewiston, Pennsylvania, and elsewhere.

Sigmund Bergmann, of New York, New York, at New York, New York, Menlo Park, New Jersey, and elsewhere.

Theodore W. Searing, of South Norwalk, Connecticut, at New York, New York, and elsewhere.

C. H. Field, of Providence, Rhode Island, at Providence, Rhode Island, and elsewhere.

O. H. Bogardus, of Syracuse, New York, at Syracuse, New York, and elsewhere.

Theodore Cooper, Crompton Mills, Warwick, Rhode Island, at Crompton Mills, Warwick, and Providence, Rhode Island, and elsewhere.

R. Kennedy, of Mt. Carmel, Connecticut, at Mt. Carmel, Connecticut, and elsewhere.

Ralph S. Mershon, of Zanesville, Ohio, at Zanesville, Ohio, and elsewhere.

L. Hillman, of Newtown, New Jersey, at Newtown, New Jersey, and elsewhere.

Frederick D. Mies, of Philadelphia, Pennsylvania, at Philadelphia, Pennsylvania, and elsewhere.

James M. Connor, of Brooklyn, New York, at Brooklyn, New York, and elsewhere.

George R. Babbitt, of Providence, Rhode Island, at Providence, Rhode Island, and elsewhere.

John C. Guerrant, of Danville, Virginia, at Danville, Virginia, and elsewhere.

Robert B. Atchison, of Boston, Massachusetts, at Boston, Massachusetts, and elsewhere.

Loring Pickering, of San Francisco, California, at San Francisco, California, and elsewhere.

A. Wilford Hall, of New York, New York, at New York, New York, and elsewhere.

Thomas L. Lagers, of Philadelphia, Pennsylvania, at Philadelphia, Pennsylvania, and elsewhere.

Milton Bradley, of Springfield, Massachusetts, at Springfield, Massachusetts, and elsewhere.

Robert N. Lockwood, of New York, at New York, New York, and elsewhere.

William A. Leggo, of New York, New York, at New York, New York, and elsewhere.

A. S. Nichols, of New Haven, Connecticut, at New Haven, Connecticut, and elsewhere.

J. Harris Rogers, of Washington, D. C., at Washington, D. C., and elsewhere.

James Webb Rogers, of New York, New York, at New York, New York, and elsewhere.

Christopher C. Reynolds, of Prescott, Arizona, at Prescott, Arizona, and elsewhere.

John Absterdam, of New York, New York, at New York, and elsewhere.

Rufus Anderson, of New York, New York, at New York, New York, Danville, Pa., and elsewhere.

Seth E. Beedy, of Farmington, Maine, at Farmington, Maine, and elsewhere.

John J. Linscott, of Farmington, Maine, at Farmington, Maine, and elsewhere.

Collett Leventhorpe, of Rutherfordton, North Carolina, at Rutherfordton, North Carolina, and elsewhere.

Samuel H. Bartlett, of New York, New York, at New York, New York, and elsewhere.

Also to others, whose names and residences and places of prior knowledge and use are at present unknown to this defendant, but which he craves leave to hereafter add as he may be advised.

19. That the things patented in the said Letters Patent No. 341,214, and in No. 341,288 and in No. 375,579, were in public use and on sale in the United States for more than two years prior to the respective dates of the respective applications for said Letters Patent in suit, and that such use and sale was had by the foregoing named persons at the foregoing named places, respectively.

20. That the thing patented in the said Letters Patent, No. 341,214, had prior to the alleged invention or discovery thereof of said Bell and Tainter been patented and described in the hereinafter mentioned Letters Patent of the United States and foreign countries.

That the thing patented in the said Letters Patent, No. 341,288, had prior to the alleged invention or discovery of said Sumner Tainter been patented and described in the hereinafter mentioned Letters Patent of the United States and foreign countries.

21. That the thing patented in the said Letters Patent No. 375,579, had prior to the alleged invention or discovery of the said Charles Sumner Tainter been patented and described in the hereinafter mentioned Letters Patent of the United States and foreign countries:

Number.	Date.	Patentee.
17,146	April 28, 1857	Charles H. Field,
32,959	July 30, 1861	O. H. Bogardus.
52,292	January 30, 1866	T. Kennedy.
56,141	July 3, 1866	Theodore Cooper.
72,521	December 24, 1867	Ralph S. Mershon.
93,619	August 10, 1869	L. Hillman.
115,934	June 13, 1871	James M. Connor.
111,859	February 14, 1871	Frederick B. Miles.
153,212	July 21, 1874	George R. Babbitt.
174,715	March 14, 1876	Robert R. Atchison.
183,920	October 31, 1876	John C. Guerrant.
191,464	May 29, 1877	Loring Pickering.
200,521	February 10, 1878	Thomas A. Edison.
201,760	March 26, 1878	Thomas A. Edison.
218,554	March 25, 1879	Thomas A. Edison.
219,939	September 23, 1879	A. Wilford Hall.
222,292	December 2, 1879	Thomas L. Luders.
225,457	March 16, 1880	Milton Bradley.
227,679	May 18, 1880	Thomas A. Edison.
231,065	August 10, 1880	Robert M. Lockwood <i>et al.</i>
232,978	October 5, 1880	John W. Kenyon.
238,929	March 15, 1881	William A. Leggo.
266,746	October 31, 1882	Seth E. Beedy.
271,903	February 6, 1883	A. S. Nichols.
277,849	May 8, 1883	J. Harris Rogers.
279,292	June 12, 1883	James H. M. Waldorp.
283,665	August 21, 1883	James W. Rogers.
287,166	October 23, 1883	Christopher C. Reynolds.
295,219	March 18, 1884	John Absterdam.
296,376	April 8, 1884	Rufus Anderson.
293,030	May 6, 1884	Albert Schmid.
305,178	September 16, 1884	George M. Guerrant <i>et al.</i>
341,212	May 4, 1886	A. G. and C. A. Bell.
341,287	May 4, 1886	Sumner Tainter.
372,786	November 8, 1887	Emile Berliner.
12,192	January 9, 1855	W. J. Casselman.

Letters Patent of Great Britain as follows:

Name.	Number.	Date.
William Mann	1912	1857
Aime L. E. Briettmayer	324	1860
Henry B. Greenwood	325	1870
Thomas A. Edison	2909	1877
Thomas A. Edison	1644	1878
Herbert J. Haddon	291	1882

Letters Patent of France as follows:

Thomas A. Edison	121,687	February 19, 1878
Patent of Addition thereto		February 19, 1878
Thomas A. Edison	129,974	September 16, 1878
Charles Cros	124,213	July 27, 1878
Patent of Addition thereto		October 3, 1878
Antonio Vicini	128,215	March 17, 1879
Charles Weyher	135,688	May 20, 1880
Patent of Addition thereto		March 23, 1880
Patent of Addition thereto		July 11, 1880
Patent of Addition thereto		September 20, 1883
Paul Goloubitzky	145,584	December 7, 1881
Patent of Addition thereto		March 15, 1882
Patent of Addition thereto		September 26, 1882
Patent of Addition thereto		September 20, 1883
Morel	146,670	March 17, 1882
Morel	146,673	March 17, 1882
Claude A. Terrier	156,749	November 8, 1883

Letters Patent of Germany as follows:

Thomas A. Edison	12,631	July 12, 1878
Kleist & Company	11,053	January 24, 1879
Thomas A. Edison	14,308	August 18, 1881
Thomas A. Edison	12,631	April 27, 1881

Letters Patent of Canada as follows:

Thomas A. Edison	8026	October 17, 1877
		Issued Oct. 20, 1877
Thomas A. Edison	9282	October 19, 1878.

Also the following Letters Patent granted to Thomas A. Edison in the countries named, to wit :

Belgium, No. 43,984, dated January 31, 1878, and No. 45,375, dated June 29, 1878.

Italy, No. 422, dated February 8, 1878, and No. — dated July 4, 1878.

Austria, dated January 1, 1879, and dated January 8, 1879.

Spain, dated May 6, 1878.

Russia, No. 1161, dated February 15/27, 1882.

Norway, dated October 8, 1878.

Sweden, dated March 29, 1879.

Denmark, No. 1345, dated October 31, 1878.

India, deposited March 20, 1879.

New South Wales, dated September 16, 1878.

Victoria, dated August 13, 1878, and No. 2549, dated August 15, 1878.

That the thing patented in the said several Letters Patent in suit, No. 341,214, No. 341,288 and No. 375,579 and all material and substantial parts thereof had prior to the date of the alleged invention and discovery of the said Bell and Taipster been fully and accurately described and published in the following printed publications, to wit :

Chemical News and Journal of Physical Science, Vol. 37, page 99 *et seq.*, published at London, March 8, 1878, by William Crookes.

Chambers' Journal, Vol. 55, page 126 *et seq.*, published at London and Edinburg, February 23, 1878, by W. and R. Chambers.

Chambers' Journal, Vol. 55, page 206 *et seq.*, published at London and Edinburg, March 30, 1878, by W. and R. Chambers.

Chambers' Journal, Vol. 55 page 256, *et seq.*, published at London and Edinburg, April 20th, 1878, by W. and R. Chambers.

Engineering, Vol. 25, page 187 *et seq.*, published at London March 8, 1878, edited by W. H. Maw and J. Dredge.

The Engineer, Vol. 46, page 84 *et seq.*, published at London, Aug. 2, 1878, by George Leopold Riche.

The Engineer, Vol. 56, page 283 *et seq.*, published at London, October 19, 1883, by George Leopold Riche.

The Gentlemen's Magazine, Vol. 20, New Series, page 688 *et seq.*, published at London, June, 1878, by Chatto and Windus.

Harper's New Monthly Magazine, Vol. 57, page 312 *et seq.*, published at New York, July, 1878, by Harper & Brothers.

Harper's New Monthly Magazine, Vol. 57, page 470 *et seq.*, published at New York, August, 1878, by Harper & Brothers.

Harper's New Monthly Magazine, Vol. 57, page 632 *et seq.*, published at New York, September 1878, by Harper & Brothers.

Harper's Weekly, Vol. 22, page 249 *et seq.*, published at New York, March 30, 1878, by Harper & Brothers.

Iron, Vol. 2, page 301 *et seq.*, published at London, March 9, 1878, by *Iron* offices.

Iron Age, page 27 *et seq.*, of issue of June 27, 1878, published at New York by David Williams.

Iron Age, page 24 *et seq.*, of issue of March 28, 1878, published at New York by David Williams.

Iron Age, page 5 *et seq.*, of issue of May 23, 1878, published at New York by David Williams.

Iron Age, page 8 *et seq.*, of August 22, 1878, published at New York by David Williams.

Journal of the Society of Telegraph Engineers and Electricians, Vol. 7, page 68 *et seq.*, published at London, February 27, 1878, by E. and F. W. Spon.

Journal of the Franklin Institute, Vol. 75, page 266 *et seq.*, published at Philadelphia, April, 1878, by the Franklin Institute.

Journal of the Franklin Institute, Vol. 75, page 348 *et seq.*, published at Philadelphia, May, 1878, by the Franklin Institute.

Journal of the Franklin Institute, Vol. 84, page 49 *et seq.*, published at Philadelphia, July, 1882, by the Franklin Institute.

Journal of the Society of Arts, Vol. 26, page 109 *et seq.*, published at London, January 11, 1878, by George Bell & Sons.

Journal of the Society of Arts, Vol. 26, page 241 *et seq.*, published in London, February 15, 1878, by George Bell & Sons.

Journal of the Society of Arts, Vol. 26, page 543 *et seq.*, published at London, May 10, 1878, by George Bell & Sons.

"Knight's New Mechanical Dictionary," page 671 *et seq.*, published at Boston in the year 1884, by Houghton, Mifflin & Co.

Manufacturer and Builder, Vol. 10, page 84 *et seq.*, published in New York, April, 1878, by H. N. Black.

Manufacturer and Builder, Vol. 11, page 95 *et seq.*, published at New York, April, 1879, by H. N. Black.

Mechanics, Vol. 5, page 319 *et seq.*, published at New York, April 26, 1884.

Nature, Vol. 17, page 90 *et seq.*, published at London and New York, November 29, 1877, by Macmillan & Co.

Nature, Vol. 17, page 190 *et seq.*, published at London and New York, January 3, 1878, by Macmillan & Co.

Nature, Vol. 17, page 291 *et seq.*, published at London and New York, February 7, 1878, by Macmillan & Co.

Nature, Vol. 17, page 415 *et seq.*, published at London and New York, March 21, 1878, by Macmillan & Co.

Nature, Vol. 17, page 384 *et seq.*, published at London, and New York, March 17, 1878, by Macmillan & Co.

Nature, Vol. 17, page 423 *et seq.*, published at London and New York, March 28, 1878, by Macmillan & Co.

Nature, Vol. 17, page 471 *et seq.*, published at London and New York, April 11, 1878, by Macmillan & Co.

Nature, Vol. 18, pages 38 and 39 *et seq.*, published at London and New York, May 9, 1878, by Macmillan & Co.

Nature, Vol. 18, pages 93 and 101 *et seq.*, published at London and New York, May 23, 1878, by Macmillan & Co.

Nature, Vol. 18, page 117 *et seq.*, published at London and New York, May 30, 1878, by Macmillan & Co.

Nature, Vol. 18, page 168 *et seq.*, published at London and New York, June 13, 1878, by Macmillan & Co.

Nature, Vol. 18, page 240 *et seq.*, published at London and New York, June 27, 1878, by Macmillan & Co.

Nature, Vol. 18, page 249 *et seq.*, published at London and New York, July 4, 1878, by Macmillan & Co.

Nature, Vol. 18, page 320 *et seq.*, published at London and New York, July 18, 1878, by Macmillan & Co.

Nature, Vol. 18, 340 *et seq.*, published at London and New York, July 25, 1878, by Macmillan & Co., and Vol. 18, page 349, August 8, 1878.

Nature, Vol. 18, page 454 *et seq.*, published at London and New York, August 22, 1878, by Macmillan & Co.

Nature, Vol. 19, page 122 *et seq.*, published at London and New York, December 12, 1878, by Macmillan & Co.

Nature, Vol. 19, page 374 *et seq.*, published at London and New York, February 25, 1879, by Macmillan & Co.

Nature, Vol. 23, page 373 *et seq.*, published at London and New York, February 17, 1878, by Macmillan & Co.

Nature, Vol. 23, page 441 *et seq.*, published at London and New York, March 10, 1881, by Macmillan & Co.

Nature, Vol. 29, page 460, *et seq.*, published at London and New York, March 13, 1884, by Macmillan & Co.

The New York Times, published at New York City, issue of March 24, 1878.

The New York Times, published at New York City, issue of April 20, 1878.

The New York Times, published at New York City, issue of April 21, 1878.

The New York Times, published at New York City, issue of June 9, 1878.

The New York Times, published at New York City, issue of February 1, 1880.

The New York Tribune, published at New York City, issue of December 26, 1877.

The New York Tribune, published at New York City, issue of January 18, 1878.

The New York Tribune, published at New York City, issue of March 21, 1878.

The New York Tribune, published at New York City, issue of March 25, 1878.

The New York Tribune, published at New York City, issue of April 6, 1878.

The New York Tribune, published at New York City, issue of April 20, 1878.

North American Review, Vol. 126, page 527, *et seq.*, published at New York, May-June, 1878, by D. Appleton & Co.

Popular Science Monthly, Vol. 12, pages 719 *et seq.* and 748 *et seq.*, published at New York, April, 1878, by D. Appleton & Co.

Quarterly Journal of Science, Vol. 8, New Series (Vol. 15, Old Series), page 245 *et seq.*, published at London, 1878, at offices of the *Quarterly Journal of Science*.

Scientific American, Vol. 37, page 376, published at New York, December 18, 1877, by Munn & Co.

Scientific American, Vol. 37, page 384 *et seq.*, published at New York, December 12, 1877, by Munn & Co.

Scientific American, Vol. 38, page 3 *et seq.*, published at New York, January 5, 1878, by Munn & Co.

Scientific American, Vol. 38, page 86 *et seq.*, published at New York, February 9, 1878, by Munn & Co.

Scientific American, Vol. 38, page 384 *et seq.*, published at New York, June 23, 1878, by Munn & Co.

Scientific American, Vol. 38, page 405 *et seq.*, published at New York, June 29, 1878, by Munn & Co.

Scientific American, Vol. 40, page 356 *et seq.*, published at New York, June 7, 1878, by Munn & Co.

Scientific American, Vol. 39, page 5 *et seq.*, published at New York, July 6, 1878, by Munn & Co.

Scientific American, Vol. 39, page 17 *et seq.*, published at New York, July 13, 1878, by Munn & Co.

Scientific American Supplement, page 1828, *et seq.*, published at New York, March 16, 1878, by Munn & Co.

Scientific American Supplement, page 1893, *et seq.*, published at New York, April 13, 1878, by Munn & Co.

Scientific American Supplement, page 1904, *et seq.*, published at New York, April 20, 1878, by Munn & Co.

Scientific American Supplement, page 1973 *et seq.*, published at New York, May 18, 1878, by Munn & Co.

Scientific American Supplement, page 2187, *et seq.*, published at New York, August 24, 1878, by Munn & Co.

Scientific American Supplement, page 3454 *et seq.*, published at New York, February 28, 1880, by Munn & Co.

Scientific American Supplement, page 2113 *et seq.*, published at New York, July 20, 1878, by Munn & Co.

The Telegraphic Journal and Electrical Review, Vol. 6, page 6 *et seq.*, published at London, January 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 182 *et seq.*, published at London, May 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 250 *et seq.*, published at London, June 15, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 53 *et seq.*, published at London, February 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 142 *et seq.*, published at London, April 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 275 *et seq.*, published at London, July 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 317 *et seq.*, published at London, August 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 385 *et seq.*, published at London, September 15, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 7,

page 53 *et seq.*, published at London, February 1, 1879, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 7, page 233 *et seq.*, published at London, July 15, 1878, by Houghton & Co.

Western Review, Vol. 1, page 681 *et seq.*, published at Kansas City, Mo., January, 1878.

Western Review, Vol. 2, page 256 *et seq.*, published at Kansas City, Mo., July, 1878.

Annual Report of Science and Industry, Vol. 7, page 399, *et seq.*, published at New York, 1877.

The American Inventor, Vol. 1, page 42 *et seq.*, published at Cincinnati, Ohio, March, 1878.

The American Inventor, Vol. 1, page 112 *et seq.*, published at Cincinnati, Ohio, July 1878.

Boston Journal of Chemistry and Popular Science Review, Vol. 12, page 122 *et seq.*, published at Boston, Mass., May, 1878.

Boston Journal of Chemistry and Popular Science Review, Vol. 16, page 76 *et seq.*, published at Boston, Mass., July, 1882.

English Mechanic and World of Science, Vol. 26, page 265 *et seq.*, published at London, November 30, 1877, by Walter Sully.

English Mechanic and World of Science, Vol. 26, page 409 *et seq.*, published at London, January 4, 1878, by Walter Sully.

English Mechanic and World of Science, Vol. 26, page 427 *et seq.*, published at London, January 11, 1878, by Walter Sully.

English Mechanic and World of Science, Vol. 27, page 80 *et seq.*, published at London, March 22, 1878, by Walter Sully.

"English Mechanic and World of Science," Vol. 27, page 559 *et seq.*, published at London, September 6, 1878, by Walter Sully.

"English Mechanic and World of Science," Vol. 29,

page 155 *et seq.*, published at London, April 25, 1879, by Walter Sully.

Industrial News, Vol. 3, page 28 *et seq.*, published at New York, February, 1882, by the Inventors' Institute.

"Minutes of Proceedings of the Institution of Civil Engineers," Vol. 53, page 329 *et seq.*, published at London, 1878, by the Institution of Civil Engineers.

Scientific and Literary Review and Journal of the Inventors' Institute, Vol. 13, page 85 *et seq.*, published at London, June, 1878.

Science News, Vol. I, page 202, *et seq.*, published at Salem, Mass., May 1, 1879.

"Transactions of the Royal Society of Edinburg," published at Edinburg, July 19, 1878.

"The Year Book of Facts in Science and the Arts," pages 86 and 88, published at London, 1878.

"Appleton's Cyclopædia of Applied Mechanics," page 531 *et seq.*, published at New York, 1879, by D. Appleton & Co.

The Advertiser, issue of May 9, 1878, published at Paris, France.

Daily Evening Traveler, issue of May 23, 1878, published at Boston, Mass.

Boston Courier, issue of June 2, 1878, published at Boston, Mass.

Boston Herald, issue of June 1, 1878, published at Boston, Mass.

Baltimore Daily News, issue of April 29, 1878, published at Baltimore, Md.

Baltimore American, issue of May 21, 1878, published at Baltimore, Md.

Boston Sunday Herald, issue of April 14, 1878, published at Boston, Mass.

The Clipper, issue of February 28, 1880, published at New York.

Cincinnati Commercial, issue of March 11, April 1, and May 5, 1878, published at Cincinnati, Ohio.

Evening Journal, issue of May 9, 1878, published at Chicago, Ill.

Cape Ann Advertiser, issue of May 24, 1878, published at Cape Ann, Mass.

Dayton Democrat, issues of April 23 and May 11, 1878, published at Dayton, Ohio.

Daily News, issue of April 10, 1878, published at London.

London Daily Telegraph, issues of April 20 and May 22, 1878, published at London.

London Times, issues of January 17 and April 20, 1878, published at London.

London Morning Post, issue of April 20, 1878, published at London.

Evening Transcript, issue of May 23, 1878, published at Boston, Mass.

Boston Daily Globe, issue of May 24, 1878, published at Boston, Mass.

Boston Journal, issues of May 23, 25, and 30, 1878, published at Boston, Mass.

Boston Post, issue of May 24, 1878, published at Boston, Mass.

Boston Daily Advertiser, issue of May 24, 1878, published at Boston, Mass.

Frank Leslie's, issue of April 20, 1878, published at New York.

London Weekly Graphic, issue of March 16, 1878, published at London.

Lancaster Intelligencer, issue of February 25, 1878, published at Lancaster, Pa.

New York Mail, issue of April 26, 1878, published at New York.

Evening Post, issue of May 24, 1878, published at New York.

The Daily Fredonian, issues of May 27 and June 6, 1878, published at New Brunswick, N. J.

Evening Express, issue of March 20, 1878, published at New York.

The New York *Sun*, issues of April 28 and August 29, 1878, published at New York.

The World, issues of March 26, April 9, May 17 and May 31, 1878, published at New York.

The Weekly Sun, issue of February 27, 1878, published at New York.

New York *Herald*, issues of February 24, April 24 and April 28, 1878.

The Weekly Witness, issue of May 2, 1878, published at New York.

Newark Register, issues of May 3 and May 17, 1878, published at Newark, N. J.

The Daily Advertiser, issue of May 3, 1878, published at Newark, N. J.

Newark Evening Journal, issue of May 3, 1878, published at Newark, N. J.

New York Graphic, issues of March 15, April 2, April 18, June 8 and August 30, 1878, published at New York.

The Operator, issues of May 1 and June 1, 1878, published at New York.

The Public, issue of May 2, 1878, published at New York.

The Sunday Times, issue of April 7, 1878, published at Philadelphia, Pa.

Pottsville *Miners' Weekly Journal*, issue of April 12, 1878, published at Pottsville, Pa.

Philadelphia *Inquirer*, issue of April 20, 1878, published at Philadelphia, Pa.

Philadelphia *Times*, issue of March 9, 1878, published at Philadelphia, Pa.

Philadelphia *Weekly Times*, issue of April 27, 1878, published at Philadelphia, Pa.

Illustrated Police News, issue of May 24, 1878, published at New York.

Philadelphia *Press*, issue of March 9, 1878, published at Philadelphia, Pa.

Philadelphia *Record*, issues of March 9 and March 21, 1878, published at Philadelphia.

Philadelphia *Ledger*, issue of March 21, 1878, published at Philadelphia, Pa.

Portsmouth *Daily Chronicle*, issue of March 12, 1878, published at Portsmouth, N. H.

The State, issue of April 30, 1878, published at Richmond, Va.

Rochester *Democrat*, issue of March 13, 1878, published at Rochester, N. Y.

San Francisco *Chronicle*, issue of March 15, 1878, published at San Francisco, Cal.

St. Joseph *Daily Herald*, issue of May 23d, 1878, published at St. Joseph, Mo.

Washington Star, issues of April 19 and May 7, 1878, published at Washington, D. C., by the Evening Star Publishing Company.

"Workshop Receipts" (Third Series), page 172, published at London, in the year 1884, by E. & F. W. Spon.

"Engineering," Vol. 27, page 326 *et seq.*, published at London, April 18, 1879, edited by W. H. Maw and J. Dredge.

"Engineering," Vol. 27, page 202 *et seq.*, published at London, March 7, 1879, edited by W. H. Maw and J. Dredge.

Comptes Rendus, Vol. 85, page 1082, *et seq.*, deposited by Ch. Cros, April 30, 1877, descriptive of phonographs and their operation.

Scientific American, Vol. 37, page 304 *et seq.*, published at New York, November 17, 1877, by Munn & Co.

Scientific American, Vol. 39, page 118 *et seq.*, published at New York, August 24, 1878, by Munn & Co.

"Haslock's Metal Turning Handbook," published at London in the year 1882.

Telegraphic Journal, Vol. 7, page 53 *et seq.*, published at London, February 1, 1879, by Houghton & Co.

Telegraphic Journal, Vol. 7, page 151 *et seq.*, published at London, May 1, 1879, by Houghton & Co.

La Nature, issue of May 4, 1879, page 349 *et seq.*

Journal of the Society of Telegraph Engineers and Electricians, Vol. 8, page 303 *et seq.*, published at London, April 9, 1879.

"The Telephone, the Microphone, and the Phonograph," by Count Du Moncel, Chapter on Phonographs, pages 235 to 261, etc., published at New York, 1879, by Harper & Brothers.

Scribner's Monthly, Vol. 15, pages 857 *et seq.*, and 899 *et seq.*, published at New York, April, 1878, by Scribner & Co.

"Popular Science Review," Vol. 2, new series, page 219 *et seq.*, published at London, 1878.

"The Speaking Telephone, Talking Phonograph and Other Novelties," by George B. Prescott, Chapter 10, pages 292 to 308 *et seq.*, published at New York, 1878.

"Ganot's Elementary Treatise on Physics," pages 241, 242 and 243, published at New York, in the year 1883, by William Wood & Company.

"Elementary Treatise on Natural Philosophy," by A. Privat Deschanel, part 3, pages 824 and 815, published at London, in the year 1872, by Blackie & Son.

"Vorschule der Experimentalphysik," pages 263 to 266, *et seq.*, published at Leipzig, in the year 1883, by Duandt & Handel.

L'Architecte, issue of April 27, 1878, published in Paris, France, in 1878.

Le Monde Illustré, issue of April 6, 1878, published in Paris, France, in 1878.

"The Universal Engineer," issue of January 17, 1879, Vol. 2, page 33 *et seq.*, published in Manchester, England, edited by R. Z. Craven.

"The World's Weekly Review of Sciences," Vol. 47, pages 580 *et seq.*, published by Abbe Moigno, September-December, 1878.

Les Monde, issue of December 12, 1878, published in Paris, France.

Scientific American, issue of June 7, 1879, published in

the City of New York, New York. (See inter Div. page 356).

"Lehrbuch Der Physik und Meteorologie," by Dr. John Muller, sixth edition in 2 vols., (see page 229, of Vol. 2), published at Braunschweig, Germany, in the year 1863.

Le Moniteur Scientifique Journal Des Sciences Pures et Appliquees, 3 Series, Vol. VIII, pp. 460, 462, published at Paris, in 1878.

And also in other printed publications at present unknown to this defendant, but which he craves leave to add hereafter as he may be advised.

22. That for the purpose of deceiving the public the respective descriptions and specifications, filed by said respective applicants in the Patent Office of the United States during the pendency of the respective applications for the patents in suit, were made to contain less than the whole truth relative to the respective alleged inventions and discoveries.

23. That in view of the state of the art at and before the date of the alleged respective inventions of the said respective patentees, and of which due proof will be made by this defendant, the said letters patent in suit do not describe anything which is lawfully the subject-matter for a patent under the laws of the United States, or which involves patentable novelty.

24. This defendant, further answering, says, that by reason of the amendments, disclaimers and arguments, filed during the pendency of the respective applications for the said letters patent in suit, the said patents, and each of them, are narrowly limited, if they should be held to be valid at all, to specific and detailed constructions of apparatus described and claimed, and that said letters patent, and each of them, were issued with their respective claims as allowed, narrowly limited to the specific constructions of apparatus and parts claimed.

25. That the said Letters Patent in suit respectively, and claims thereof, claim more than was, or is, the invention of the respective patentees.

That the said Bell and Tainter are not and never were

the joint inventors of the alleged invention described and claimed in Letters Patent, No. 341,214, and that said Sumner Tainter and Charles Sumner Tainter are not and never were the inventors respectively of the alleged inventions described and claimed in the said Letters Patent, No. 341,288 and No. 375,579, respectively.

26. And this defendant is advised and believes, and thereupon submits to this Honorable Court, that by reason of the foregoing facts, severally specified, the said Letters-Patent in suit, No. 341,214 and No. 375,579, were and are null and void: and this defendant denies that it has ever infringed; or intended to infringe, or does now infringe, or threatens or intends to infringe, upon any of the rights of the complainant, and denies that it has realized or acquired any profits or gains whatsoever by reason of any infringements of any rights of the complainant, and denies that the complainant will be subject, as alleged, to great, irrepairable damage or loss, or to any damage or loss whatsoever, if it does not obtain the relief sought and prayed for in its said Bill of Complaint.

27. In answer to the interrogatories propounded on page 11 of the said Bill of Complaint, this defendant would say:

"One.—This defendant has not made or sold any gramophones containing any of Complainant's said patented devises."

"Two.—This defendant has not made or sold any gramophones records containing any of complainant's said patented features."

28. And further answering, and not waiving any, but insisting upon all and singular the matters and things herein set forth, this defendant further says, by way of defence to the said Bill of Complaint, that this action is an attempt, under a cover of alleged infringement of certain patents alleged to belong to the complainant, to drive this defendant out of the business of manufacturing and selling Sound Recording and Reproducing Apparatus and records, which it has a perfect right to sell and use under sundry Letters Patent of the United States issued to Emile Berliner and Werner

Suess, both of Washington, D. C., for sundry improvements relative to Sound Recording and Reproducing, among others—*ato-wit*, No. 272,786, dated November 8, 1887, No. 382,490, dated May 15, 1888, and No. 524,543, dated February 19, 1895.

This defendant further answering says that by virtue of certain agreement of license it has been selling to the public the Sound Reproducing Machine, known, commercially, as the Berliner Gramophone, and Berliner records therefor, for the past three or four years to the extent of many hundreds of thousands, and has built up a large trade; that in the year 1898 the public has paid for said Gramophone apparatus amounts approximating three-quarters of a million of dollars.

That the said Berliner Gramophone is a radically different type of apparatus and operated upon a radically different principle from the apparatus described and claimed in the respective patents in suit, and has always been so recognized by the trade and the public at large, as well as by experts and professional men.

And this defendant further avers that it was so recognized as long ago as 1891 by one of complainant's counsel in this case, who, in a written opinion given to Mr. Berliner at that time, counselled and advised him that the said apparatus of defendant, commercially known as the Gramophone, can be used in this country without infringement of any existing and valid patent, emphasizing the marked distinctions and differences between the Berliner Gramophone and the apparatus and method of Bell and Tainter.

That not until suit was brought when the said large trade was built up by this defendant, and the superiority of the Gramophone as a commercial apparatus was so generally and publicly recognized over all other sound recording and reproducing apparatus, including the complainants, did complainants ever make any claim to defendants that defendants machine or apparatus, or any part thereof, infringed any of the alleged inventions of the patents in

suit, or any other of their inventions; and this defendant avers that the present is an unjust attempt on the part of the defendant to injure defendants' legitimate trade and business.

29. This defendant further says and avers that should an injunction issue against him, as prayed in the said Bill of Complaint, the said defendant will suffer thereby great and irreparable damage and injury; that the complainant has already, by means of threatening, unfair and unjust circulars, letters and advertisements issued and published by it and circulated amongst the defendant's customers and the trade and public generally, greatly injured and damaged defendant's business and trade, said threatening communications illegally and unjustly notifying defendant's customers and the public generally that defendant's machines and apparatus are made, sold and used in violation of complainant's said patents and are infringements thereof, and that all who sell or use the same will be held as infringers and legally proceeded against by the said complainant to the great and irreparable damage, loss and injury of the said defendants, and the said defendant prays that the said complainant be enjoined and estopped from continuing the issue of such threatening and damaging communications, advertisements, etc. This defendant denies, as it has before denied, that the complainant has suffered or will suffer any damage or injury whatsoever by reason of any act or acts of this defendant in the premises.

All of which things this defendant is ready and willing to aver, maintain and prove as this Honorable Court shall direct.

This defendant prays the benefit of all the matters and things hereinbefore set forth and alleged, as if the same were specially pleaded where a plea would have been proper, or, as, if on account thereof, it had demurred to the said Bill of Complaint, or to part or parts thereof, where a demurrer would have been proper; without this, that any other matter or thing in the complainant's Bill

contained, material or effectual to be answered, traversed, confessed and avoided, or denied, is true, all of which things this defendant will maintain and prove as this Honorable Court shall direct.

And humbly prays to be hence dismissed with its reasonable costs and charges in this behalf most wrongfully sustained.

HORACE PETTIT,

*Solicitor and of Counsel for Berlin Gramophone
Company, Defendant.*

March 6th, 1899.

IN THE
Circuit Court of the United States,
EASTERN DISTRICT OF PENNSYLVANIA.

October Sessions, 1898. No. 34.

IN EQUITY.

AMERICAN GRAPHOPHONE COMPANY,
Complainant,

vs.

BERLINER GRAMOPHONE COMPANY, THOMAS
S. PARVIN, AND E. R. JOHNSON,
Defendants.

The Answer of Thomas S. Parvin, one of the above named defendants, individually and as President of the said Berliner Gramophone Company, to the Bill of Complaint of the American Graphophone Company, the above named complainant.

This respondent now and at all times hereafter saving and reserving to himself any and all manner of benefit or advantage of exceptions, or otherwise, that can or may be had to the many errors, uncertainties and imperfections in the said Bill of Complaint contained, for answer to said Bill, or so much thereof as the defendant is advised is material or necessary for him to make answer unto, answering says:

Whether the said complainant, the American Graphophone Company, is a corporation duly organized and existing

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under the laws of the State of West Virginia this defendant does not know save by information contained in said Bill of Complaint, and calls upon said complainant for proof thereof.

1. This defendant denies that Chichester A. Bell and Sumner Tainter were the original, first or joint inventors of the alleged improvements in recording and reproducing speech and other sounds referred to in paragraph 1 of the Bill of Complaint, and denies that the same were not known or used by others in this country before the date of their alleged invention by the said Bell and Tainter, and denies that they were not patented or described in any printed publication in this or any foreign country before the invention of the said Bell and Tainter, and denies that they were not in public use or on sale in the United States for more than two years prior to the date of the application of the said Bell and Tainter for a patent therefor, and denies that the same had not been abandoned to the public.

2. This defendant believes and admits that certain Letters Patent of the United States, No. 341,214, dated May 4, 1886, were issued to the said Chichester A. Bell and Sumner Tainter for certain alleged Improvements in Recording and Reproducing Speech and other Sound, but denies that the said Bell and Tainter in making application therefor complied in all respects with the provisions and requirements of the laws of the United States in such cases made and provided; and denies that any valid, exclusive rights were acquired by virtue of the issue of the said Letters Patent.

3. This defendant denies that the said Sumner Tainter was the original, first and sole inventor of the alleged improvement in Apparatus for Recording and Reproducing Sounds or Sonorous Vibrations, as averred in paragraph 3 of the Bill of Complaint, and denies that the said alleged invention was not known or used by others in this country, or patented or described in any printed publication in this or any foreign country prior to the date of the alleged invention of the said Tainter, and denies that the same was not in public

use or on sale in the United States for more than two years prior to the application for Letters Patent therefor; and denies that the same has not been abandoned to the public.

4. This defendant believes and admits that certain Letters Patent of the United States, No. 341,288, dated May 4, 1886, were issued to the said Sumner Tainter for certain alleged Improvement in Recording and Reproducing Sound, but denies that the said Tainter in making application therefor fully complied with the provisions and requirements of the laws of the United States in such cases made and provided; and denies that any valid, exclusive rights were acquired by virtue of the issue of said Letters Patent,

5. This defendant denies that the said Charles Sumner Tainter was the original, sole and first inventor of the alleged Improvement in Apparatus for Recording and Reproducing Speech and other Sound referred to in paragraph 5 of the Bill of Complaint; and denies that the said invention was not known and used by others in this country, or patented or described in any printed publication in this or any foreign country before the date of the alleged invention of the said Tainter, and denies that the same was not in public use or on sale in the United States for more than two years prior to the date of the application for the said Letters Patent; and denies that the same was not abandoned to the public.

6. This defendant believes and admits that certain Letters Patent of the United States, No. 375,579, dated December 27, 1887, were issued to the said Charles Sumner Tainter for certain alleged Improvements in Apparatus for Recording and Reproducing Speech and other Sounds, but denies that the said Charles Sumner Tainter in making application therefor fully complied with the requirements and provisions of the laws of the United States in such case made and provided, and denies that any valid exclusive rights were acquired by virtue of the issue of said Letters Patent.

7. This defendant denies that the said alleged inventions and improvements described in the said Letters Patent No. 341,214, No. 341,288 and No. 375,579, were designed for or are capable of conjoint use in the legal sense of the term, and denies that they are thus conjointly used by defendants.

8. This defendant does not know and has no information, save by said Bill of Complaint, whether said Letters Patent No. 341,214 were assigned by the said Bell and Tainter to the Volta Graphophone Company, as alleged in paragraph 8 of the Bill of Complaint, and calls upon the complainant for proof thereof.

9. This defendant does not know and has no information, save by said Bill of Complaint, whether said Letters Patent No. 341,288, were duly assigned by the said Sumner Tainter to the said Volta Graphophone Company, and calls upon the complainant for proof thereof.

10. This defendant does not know and has no information, save by said Bill of Complaint, whether said Letters Patent No. 375,579, were duly assigned by the said Charles Sumner Tainter to the said Volta Graphophone Company, and calls upon the complainant for proof thereof.

11. This defendant does not know and has no information, save by said Bill of Complaint, whether said Letters Patent No. 341,214, No. 341,288 and No. 375,579, or any of them, were duly assigned unto the complainant, the American Graphophone Company, by the said Volta Graphophone Company, and calls upon the complainant for proof thereof.

12. This defendant denies that he has ever made, sold or used, directly or indirectly, any constructions or devices which infringe any of the claims of any of the said Letters Patent hereinbefore referred to; and denies that the complainant is now, or ever was, the sole and exclusive owner of any rights acquired under or by virtue of the said Letters Patent, or otherwise, which this defendant has infringed.

13. This defendant denies that the complainant has expended large sums of money in practicing and introducing to the public any invention or improvement which this defendant has made, sold or used, directly or indirectly, and denies that there has been any public acquiescence that Bell and Tainter were the first original inventors of the devices and constructions which the complainants by the said Bill of Complaint claim broadly were the inventions of the said Bell and Tainter, and denies that the said patents are good and valid patents; and this defendant denies that the public have acknowledged these claims of the complainant to the exclusive right to the said alleged inventions under the said patents; and this defendant denies that he has done or performed any acts, directly or indirectly, which have infringed or interfered with any rights of the complainant in the premises.

14. This defendant is informed and believes that the said complainant did file a Bill of Complaint in the United States Circuit Court for the Southern District of New York, to enjoin the manufacture, use and sale of a machine known as the "Metaphone," and that the Court, in a decision by Judge SHIPMAN (87 Fed. Rep., 873), held that the said "Metaphone," as an organized whole, infringed claims 19 to 24 of Letters Patent No. 341,214; but this defendant avers that the said "Metaphone" embodies a construction and combination relative to the said claims which is absolutely and totally dissimilar from the construction and operation of any machine or device which this defendant has made, used or sold, directly or indirectly, and he is informed and believes that the decision of Judge SHIPMAN relative to the said "Metaphone" has no application whatsoever to any device that this defendant has ever made, used or sold; and this defendant is informed and believes that the construction given by Judge SHIPMAN to the said claims would positively preclude their application to any device or combination of parts which this defendant may have at any time made, sold or used.

15. This defendant denies that the said E. R. Johnson, or others acting in concert with him, has made or caused to be made for the Berliner Gramophone Company, or for this defendant, or sold to them or either of them, apparatus or parts of apparatus adapted or intended to be used for recording and reproducing speech, or other sounds, substantially as described and claimed in said Letters Patent No. 341,214, No. 341,288 or No. 375,579; and denies that the said Johnson has sold or delivered to the said Berliner Gramophone Company, or to this defendant, at any time, any devices such as described and claimed in any of the said letters patent, or any parts of such devices for any purpose whatsoever. This defendant denies that the said Berliner Gramophone Company, or this defendant, has assembled or employed any parts received from the said Johnson, or from any other source, which form any apparatus whatsoever embodying the construction claimed in any of the said letters patent; and denies that he has in any manner infringed any of the said letters patent, or has done any acts whatsoever with the intent to injure the complainant, or to deprive it of any just profits to which it may be entitled, from or arising out of the said patents in suit, or any of them.

This defendant denies that he has conspired or concerted with any party or parties in any infringement of, or in any attempt to infringe, directly or indirectly, any of the rights of this complainant under or by virtue of the said letters patent in suit, or any of them; and denies that he has threatened individually, or in concert with others, directly or indirectly to so infringe any of the rights of this complainant in the premises; and denies that the complainant, by any acts of this defendant, or any acts of these defendants, has suffered any irreparable loss or injury, or any loss or injury whatsoever; and denies that this complainant has by any unlawful act of this defendant, or any of these defendants, been deprived of any gains or profits whatsoever; and this defendant denies that he, or any of the said defendants, have ever received or derived, or are receiving or deriving any gains or profits whatsoever by reason of any infringement of the rights of the complainant in the premises, or otherwise.

16. This defendant denies that he has by any acts whatsoever encouraged or induced others to infringe the said Letters Patent in suit, or any of them.

17. This defendant denies that he was duly notified by complainant of the alleged infringement complained of in said Bill of Complaint, and denies that he refused to desist from any infringement of any rights of the complainant in the premises.

This defendant avers that the complainant has wholly failed to comply with the requirements of Section 4909 of the Revised Statutes of the United States, in that it has wholly failed to give public notice of the fact of the issue of the said respective Letters Patent, or of the number or date of the same of any claim it had, or pretended to have had, or to have, to the exclusive use of the said respective alleged invention by virtue of the said respective Letters Patent in suit, or otherwise, by marking, stamping, or otherwise affixing notice to said respective alleged patented improvements in suit as made, sold or used by the complainant; but that it has failed to mark the said alleged patented improvements as required by said Section of the Revised Statutes.

This defendant, further answering, and not waiving any, but insisting upon all and singular the matters herein set forth, further says by way of defense to the said Bill of Complaint, upon information and belief, that the said Letters Patent in suit, and each of them, are null and void, for the reasons as follows, to wit:

18: That the said Chichester A. Bell and Sumner Tainter, the alleged joint inventors of the alleged Improvements in Recording and Reproducing Speech and other Sounds, described and claimed in said Letters Patent No. 341,214, were not the true, original or first inventors or discoverers, or joint inventors or discoverers, of the said alleged Improvement described in the said Letters Patent, nor of any material or substantial part thereof, but that the thing patented in the said Letters Patent No. 341,214 was prior to the alleged invention or discovery of the said Bell and Tainter known to

and used by the hereinafter mentioned persons at the hereinafter mentioned places, respectively.

That the said Sumner Tainter, the alleged inventor of the Apparatus for Recording and Reproducing Sounds, described and claimed in Letters Patent No. 341,288, was not the true, original or first inventor or discoverer of the said alleged improvement described and claimed in said Letters Patent, nor of any material or substantial part thereof, but that the thing patented in the said Letters Patent No. 341,288 was prior to the alleged invention or discovery of the said Tainter, known to and used by the hereinafter mentioned persons at the hereinafter mentioned places, respectively.

That the said Charles Sumner Tainter, the alleged inventor of the Apparatus for Recording and Reproducing Speech and other Sounds, described and claimed in the said Letters Patent, No. 375,579, was not the true, original or first inventor, or discoverer, of the said alleged Improvement described and claimed in said Letters Patent, nor of any material or substantial part thereof, but that the thing patented in the said Letters Patent, No. 375,579, was prior to the alleged invention or discovery of the said Charles Sumner Tainter known to and used by the hereinafter mentioned persons at the hereinafter mentioned places, respectively, to wit:

Thomas A. Edison, of Llewellyn Park, New Jersey, at Menlo Park, New Jersey, and elsewhere.

Emile Berliner, of Washington, D. C., at Washington, D. C., and elsewhere.

John F. Ott, of Orange, New Jersey, at Menlo Park, Orange, New Jersey, and elsewhere.

Edward H. Johnson, of Greenwich, Connecticut, at Menlo Park, New Jersey, New York, New York, and elsewhere.

Charles Batchelor, of New York, New York, at Menlo Park, New Jersey, New York, New York, and elsewhere.

John Kruesi, Schenectady, New York, at Menlo Park, New Jersey, New York, New York, and elsewhere.

James U. McKenzie, of Brooklyn, New York, at Menlo Park, New Jersey, New York, New York, and elsewhere.

George H. Harrington, of Wichita, Kansas, at Wichita, Kansas, and elsewhere.

Frank Lambert, of Brooklyn, New York, at Ansonia, Connecticut, Jamaica, Brooklyn, and New York, New York, and elsewhere.

Eugene Pastre, of Brooklyn, New York, at Ansonia, Connecticut, at Jamaica, Brooklyn, and New York, New York, and elsewhere.

Walter D. Davis, of Brooklyn, New York, at Ansonia, Connecticut, Jamaica, Brooklyn, and New York, New York, and elsewhere.

Isaac W. Heysinger, of Philadelphia, Pennsylvania, at Philadelphia, Pennsylvania, and elsewhere.

Ansonia Clock Co., of Ansonia, Connecticut, at Ansonia, Connecticut, and elsewhere.

Clarence J. Blake, of Boston, Massachusetts, at Boston, Massachusetts, Washington, D. C., and elsewhere.

Clarence E. Gifford, of Jamestown, New York, at Jamestown, New York, Chicago, Illinois, Lewiston, Pennsylvania, and elsewhere.

Sigmund Bergmann, of New York, New York, at New York, New York, Menlo Park, New Jersey, and elsewhere.

Theodore W. Searing, of South Norwalk, Connecticut, at New York, New York, and elsewhere.

C. H. Field, of Providence, Rhode Island, at Providence, Rhode Island, and elsewhere.

O. H. Bogardus, of Syracuse, New York, at Syracuse, New York, and elsewhere.

Theodore Cooper, Crompton Mills, Warwick, Rhode Island, at Crompton Mills, Warwick, and Providence, Rhode Island, and elsewhere.

R. Kennedy, of Mt. Carmel, Connecticut, at Mt. Carmel, Connecticut, and elsewhere.

Ralph S. Merzhom, of Zanesville, Ohio, at Zanesville, Ohio, and elsewhere.

L. Hillman, of Newtown, New Jersey, at Newtown, New Jersey, and elsewhere.

Frederick D. Miles, of Philadelphia, Pennsylvania, at Philadelphia, Pennsylvania, and elsewhere.

James M. Connor, of Brooklyn, New York, at Brooklyn, New York, and elsewhere.

George R. Babbitt, of Providence, Rhode Island, at Providence, Rhode Island, and elsewhere.

John C. Guerrant, of Danville, Virginia, at Danville, Virginia, and elsewhere.

Robert B. Atchison, of Boston, Massachusetts, at Boston, Massachusetts, and elsewhere.

Loring Pickering, of San Francisco, California, at San Francisco, California, and elsewhere.

A. Wilford Hall, of New York, New York, at New York, New York, and elsewhere.

Thomas L. Lagers, of Philadelphia, Pennsylvania, at Philadelphia, Pennsylvania, and elsewhere.

Milton Bradley, of Springfield, Massachusetts, at Springfield, Massachusetts, and elsewhere.

Robert N. Lockwood, of New York, at New York, New York, and elsewhere.

William A. Leggo, of New York, New York, at New York, New York, and elsewhere.

A. S. Nichols, of New Haven, Connecticut, at New Haven, Connecticut, and elsewhere.

J. Harris Rogers, of Washington, D. C., at Washington, D. C., and elsewhere.

James Webb Rogers, of New York, New York, at New York, New York, and elsewhere.

Christopher C. Reynolds, of Prescott, Arizona, at Prescott, Arizona, and elsewhere.

John Absterdam, of New York, New York, at New York, and elsewhere.

Rufus Anderson, of New York, New York, at New York, New York, Danville, Pa., and elsewhere.

Seth E. Beedy, of Farmington, Maine, at Farmington, Maine, and elsewhere.

John J. Linscott, of Farmington, Maine, at Farmington, Maine, and elsewhere.

Collett Leventhorpe, of Rutherfordton, North Carolina, at Rutherfordton, North Carolina, and elsewhere.

Samuel H. Bartlett, of New York, New York, at New York, New York, and elsewhere.

Also to others, whose names and residences and places of prior knowledge and use are at present unknown to this defendant, but which he craves leave to hereafter add as he may be advised.

19. That the things patented in the said Letters Patent No. 341,214, and in No. 341,288 and in No. 375,579, were in public use and on sale in the United States for more than two years prior to the respective dates of the respective applications for said Letters Patent in suit, and that such use and sale was had by the foregoing named persons at the foregoing named places, respectively.

20. That the thing patented in the said Letters Patent, No. 341,214, had prior to the alleged invention or discovery thereof of said Bell and Tainter been patented and described in the hereinafter mentioned Letters Patent of the United States and foreign countries.

That the thing patented in the said Letters Patent, No. 341,288, had prior to the alleged invention or discovery of said Sumner Tainter been patented and described in the hereinafter mentioned Letters Patent of the United States and foreign countries.

21. That the thing patented in the said Letters Patent No. 375,579, had prior to the alleged invention or discovery of the said Charles Sumner Tainter been patented and described in the hereinafter mentioned Letters Patent of the United States and foreign countries:

Number.	Date.	Patentee.
17,146	April 28, 1857	Charles H. Field.
32,959	July 30, 1861	O. H. Bogardus.
52,292	January 30, 1866	T. Kennedy.
56,141	July 3, 1866	Theodore Cooper.
72,521	December 24, 1867	Ralph S. Mershom.
98,619	August 10, 1869	L. Hillman.
115,934	June 13, 1871	James M. Connor.
111,859	February 14, 1871	Frederick B. Miles.
153,212	July 21, 1874	George R. Babbitt.
174,715	March 14, 1876	Robert R. Atchison.
188,920	October 31, 1876	John C. Guerrant.
191,464	May 29, 1877	Loring Pickering.
200,521	February 10, 1878	Thomas A. Edison.
201,760	March 26, 1878	Thomas A. Edison.
213,554	March 25, 1879	Thomas A. Edison.
219,939	September 23, 1879	A. Wilford Hall.
222,292	December 2, 1879	Thomas L. Luders.
225,457	March 16, 1880	Milton Bradley.
227,679	May 18, 1880	Thomas A. Edison.
231,065	August 10, 1880	Robert M. Lockwood, <i>et al.</i>
232,978	October 5, 1880	John W. Kenyon.
238,929	March 15, 1881	William A. Leggo.
266,746	October 31, 1882	Seth E. Beedy.
271,903	February 6, 1883	A. S. Nichols.
277,349	May 8, 1883	J. Harris Rogers.
279,292	June 12, 1883	James H. M. Waldorp.
283,665	August 21, 1883	James W. Rogers.
287,166	October 23, 1883	Christopher C. Reynolds.
295,219	March 18, 1884	John Absterdam.
296,376	April 8, 1884	Rufus Anderson.
293,030	May 6, 1884	Albert Schmid.
305,178	September 16, 1884	George M. Guerrant, <i>et al.</i>
341,212	May 4, 1886	A. G. and C. A. Bell.
341,287	May 4, 1886	Sumner Tainter.
372,786	November 8, 1887	Emile Berliner.
12,192	January 9, 1855	W. J. Casselman.

Letters Patent of Great Britain, as follows:

Name.	Number.	Date.
William Mann	1912	1857
Aime L. E. Briettmayer	324	1860
Henry B. Greenwood	325	1870
Thomas A. Edison	2909	1877
Thomas A. Edison	1644	1878
Herbert J. Haddon	291	1882

Letters Patent of France, as follows:

Thomas A. Edison	121,687	February 19, 1878
Patent of Addition thereto		February 19, 1878
Thomas A. Edison	129,974	September 16, 1878
Charles Cros	124,213	July 27, 1878
Patent of Addition thereto		October 3, 1878
Antonio Vicini	128,215	March 17, 1879
Charles Weyher	135,688	May 20, 1880
Patent of Addition thereto		March 23, 1880
Patent of Addition thereto		July 11, 1880
Patent of Addition thereto		September 20, 1883
Paul Goloubitzky	145,584	December 7, 1881
Patent of Addition thereto		March 15, 1882
Patent of Addition thereto		September 26, 1882
Patent of Addition thereto		September 20, 1883
Morel	146,670	March 17, 1882
Morel	146,673	March 17, 1882
Claude A. Terrier	156,749	November 8, 1883

Letters Patent of Germany as follows:

Thomas A. Edison	12,631	July 12, 1878
Kleist & Company	11,053	January 24, 1879
Thomas A. Edison	14,308	August 18, 1881
Thomas A. Edison	12,631	April 27, 1881

Letters Patent of Canada as follows:

Thomas A. Edison	8026	October 17, 1877
		Issued Oct. 20, 1877
Thomas A. Edison	9282	October 19, 1878.

Also the following Letters Patent granted to Thomas A. Edison in the countries named, to wit :

Belgium, No. 43,984, dated January 31, 1878, and No. 45,375, dated June 29, 1878.

Italy, No. 422, dated February 8, 1878, and No. — dated July 4, 1878.

Austria, dated January 1, 1879, and dated January 8, 1879.

Spain, dated May 6, 1878.

Russia, No. 1161, dated February 15/27, 1882.

Norway, dated October 8, 1878.

Sweden, dated March 29, 1879.

Denmark, No. 1345, dated October 31, 1878.

India, deposited March 20, 1879.

New South Wales, dated September 16, 1878.

Victoria, dated August 13, 1878, and No. 2549, dated August 15, 1878.

That the thing patented in the said several Letters Patent in suit, No. 341,214, No. 341,288 and No. 375,579, and all material and substantial parts thereof had prior to the date of the alleged invention and discovery of the said Bell and Tainter been fully and accurately described and published in the following printed publications, to wit :

Chemical News and Journal of Physical Science, Vol. 37, page 99, *et seq.*, published at London, March 8, 1878, by William Crookes.

Chambers' Journal, Vol. 55, page 126, *et seq.*, published at London and Edinburg, February 23, 1878, by W. and R. Chambers.

Chambers' Journal, Vol. 55, page 206, *et seq.*, published at London and Edinburg, March 30, 1878, by W. and R. Chambers.

Chambers' Journal, Vol. 55 page 256, *et seq.*, published at London and Edinburg, April 20th, 1878, by W. and R. Chambers.

Engineering, Vol. 25, page 187 *et seq.*, published at London March 8, 1878, edited by W. H. Maw and J. Dredge.

The Engineer, Vol. 46, page 84 *et seq.*, published at London, Aug. 2, 1878, by George Leopold Riche.

The Engineer, Vol. 56, page 283 *et seq.*, published at London, October 19, 1883, by George Leopold Riche.

The Gentlemen's Magazine, Vol. 20, New Series, page 688 *et seq.*, published at London, June, 1878, by Chatto and Windus.

Harper's New Monthly Magazine, Vol. 57, page 312 *et seq.*, published at New York, July, 1878, by Harper & Brothers.

Harper's New Monthly Magazine, Vol. 57, page 470 *et seq.*, published at New York, August, 1878, by Harper & Brothers.

Harper's New Monthly Magazine, Vol. 57, page 632 *et seq.*, published at New York, September 1878, by Harper & Brothers.

Harper's Weekly, Vol. 22, page 249 *et seq.*, published at New York, March 30, 1878, by Harper & Brothers.

Iron, Vol. 2, page 301 *et seq.*, published at London, March 9, 1878, by *Iron* offices.

Iron Age, page 27 *et seq.*, of issue of June 27, 1878, published at New York by David Williams.

Iron Age, page 24 *et seq.*, of issue of March 28, 1878, published at New York by David Williams.

Iron Age, page 5 *et seq.*, of issue of May 23, 1878, published at New York by David Williams.

Iron Age, page 8 *et seq.*, of August 22, 1878, published at New York by David Williams.

Journal of the Society of Telegraph Engineers and Electricians, Vol. 7, page 68 *et seq.*, published at London, February 27, 1878, by E. and F. W. Spon.

Journal of the Franklin Institute, Vol. 75, page 266 *et seq.*, published at Philadelphia, April, 1878, by the Franklin Institute.

Journal of the Franklin Institute, Vol. 75, page 348 *et seq.*, published at Philadelphia, May, 1878, by the Franklin Institute.

Journal of the Franklin Institute, Vol. 84, page 49 *et seq.*, published at Philadelphia, July, 1882, by the Franklin Institute.

Journal of the Society of Arts, Vol. 26, page 109 *et seq.*, published at London, January 11, 1878, by George Bell & Sons.

Journal of the Society of Arts, Vol. 26, page 241 *et seq.*, published in London, February 15, 1878, by George Bell & Sons.

Journal of the Society of Arts, Vol. 26, page 543 *et seq.*, published at London, May 10, 1878, by George Bell & Sons.

"Knight's New Mechanical Dictionary," page 671 *et seq.*, published at Boston in the year 1884, by Houghton, Mifflin & Co.

Manufacturer and Builder, Vol. 10, page 84 *et seq.*, published in New York, April, 1878, by H. N. Black.

Manufacturer and Builder, Vol. 11, page 95 *et seq.*, published at New York, April, 1879, by H. N. Black.

Mechanics, Vol. 5, page 319 *et seq.*, published at New York, April 26, 1884.

Nature, Vol. 17, page 90 *et seq.*, published at London and New York, November 29, 1877, by Macmillan & Co.

Nature, Vol. 17, page 190 *et seq.*, published at London and New York, January 3, 1878, by Macmillan & Co.

Nature, Vol. 17, page 291 *et seq.*, published at London and New York, February 7, 1878, by Macmillan & Co.

Nature, Vol. 17, page 415 *et seq.*, published at London and New York, March 21, 1878, by Macmillan & Co.

Nature, Vol. 17, page 384 *et seq.*, published at London, and New York, March 17, 1878, by Macmillan & Co.

Nature, Vol. 17, page 423 *et seq.*, published at London and New York, March 28, 1878, by Macmillan & Co.

Nature, Vol. 17, page 471 *et seq.*, published at London and New York, April 11, 1878, by Macmillan & Co.

Nature, Vol. 18, pages 38 and 39 *et seq.*, published at London and New York, May 9, 1878, by Macmillan & Co.

Nature, Vol. 18, pages 93 and 101 *et seq.*, published at London and New York, May 23, 1878, by Macmillan & Co.

Nature, Vol. 18, page 117 *et seq.*, published at London and New York, May 30, 1878, by Macmillan & Co.

Nature, Vol. 18, page 168 *et seq.*, published at London and New York, June 13, 1878, by Macmillan & Co.

Nature, Vol. 18, page 240 *et seq.*, published at London and New York, June 27, 1878, by Macmillan & Co.

Nature, Vol. 18, page 249 *et seq.*, published at London and New York, July 4, 1878, by Macmillan & Co.

Nature, Vol. 18, page 320 *et seq.*, published at London and New York, July 18, 1878, by Macmillan & Co.

Nature, Vol. 18, 340 *et seq.*, published at London and New York, July 25, 1878, by Macmillan & Co., and Vol. 18, page 349, August 8, 1878.

Nature, Vol. 18, page 454 *et seq.*, published at London and New York, August 22, 1878, by Macmillan & Co.

Nature, Vol. 19, page 122 *et seq.*, published at London and New York, December 12, 1878, by Macmillan & Co.

Nature, Vol. 19, page 374 *et seq.*, published at London and New York, February 25, 1879, by Macmillan & Co.

Nature, Vol. 23, page 373 *et seq.*, published at London and New York, February 17, 1878, by Macmillan & Co.

Nature, Vol. 23, page 441 *et seq.*, published at London and New York, March 10, 1881, by Macmillan & Co.

Nature, Vol. 29, page 460, *et seq.*, published at London and New York, March 13, 1884, by Macmillan & Co.

The New York Times, published at New York City, issue of March 24, 1878.

The New York Times, published at New York City, issue of April 20, 1878.

The New York Times, published at New York City, issue of April 21, 1878.

The New York Times, published at New York City, issue of June 9, 1878.

The New York Times, published at New York City, issue of February 1, 1880.

The New York Tribune, published at New York City, issue of December 26, 1877.

The New York Tribune, published at New York City, issue of January 18, 1878.

The New York Tribune, published at New York City, issue of March 21, 1878.

The New York Tribune, published at New York City, issue of March 25, 1878.

The New York Tribune, published at New York City, issue of April 6, 1878.

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North American Review, Vol. 126, page 527, *et seq.*, published at New York, May-June, 1878, by D. Appleton & Co.

Popular Science Monthly, Vol. 12, pages 719 *et seq.* and 748 *et seq.*, published at New York, April, 1878, by D. Appleton & Co.

Quarterly Journal of Science, Vol. 8, New Series (Vol. 15, Old Series), page 24b *et seq.*, published at London, 1878, at offices of the *Quarterly Journal of Science*.

Scientific American, Vol. 37, page 376, published at New York, December 18, 1877, by Munn & Co.

Scientific American, Vol. 37, page 384 *et seq.*, published at New York, December 12, 1877, by Munn & Co.

Scientific American, Vol. 38, page 3 *et seq.*, published at New York, January 5, 1878, by Munn & Co.

Scientific American, Vol. 38, page 86 *et seq.*, published at New York, February 3, 1878, by Munn & Co.

Scientific American, Vol. 38, page 384 *et seq.*, published at New York, June 23, 1878, by Munn & Co.

Scientific American, Vol. 38, page 405 *et seq.*, published at New York, June 29, 1878, by Munn & Co.

Scientific American, Vol. 40, page 356 *et seq.*, published at New York, June 7, 1878, by Munn & Co.

Scientific American, Vol. 39, page 5 *et seq.*, published at New York, July 6, 1878, by Munn & Co.

Scientific American, Vol. 39, page 17 *et seq.*, published at New York, July 13, 1878, by Munn & Co.

Scientific American Supplement, page 1828, *et seq.*, published at New York, March 16, 1878, by Munn & Co.

Scientific American Supplement, page 1893, *et seq.*, published at New York, April 13, 1878, by Munn & Co.

Scientific American Supplement, page 1904, *et seq.*, published at New York, April 20, 1878, by Munn & Co.

Scientific American Supplement, page 1973 *et seq.*, published at New York, May 18, 1878, by Munn & Co.

Scientific American Supplement, page 2187, *et seq.*, published at New York, August 24, 1878, by Munn & Co.

Scientific American Supplement, page 3454 *et seq.*, published at New York, February 28, 1880, by Munn & Co.

Scientific American Supplement, page 2113 *et seq.*, published at New York, July 20, 1878, by Munn & Co.

The Telegraphic Journal and Electrical Review, Vol. 6, page 6 *et seq.*, published at London, January 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 182 *et seq.*, published at London, May 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 250 *et seq.*, published at London, June 15, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 53 *et seq.*, published at London, February 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 142 *et seq.*, published at London, April 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 275 *et seq.*, published at London, July 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 317 *et seq.*, published at London, August 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 385 *et seq.*, published at London, September 15, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 7,

page 53 *et seq.*, published at London, February 1, 1879, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 7, page 233 *et seq.*, published at London, July 15, 1878, by Houghton & Co.

Western Review, Vol. 1, page 681 *et seq.*, published at Kansas City, Mo., January, 1878.

Western Review, Vol. 2, page 256 *et seq.*, published at Kansas City, Mo., July, 1878.

Annual Report of Science and Industry, Vol. 7, page 399, *et seq.*, published at New York, 1877.

The American Inventor, Vol. 1, page 42 *et seq.*, published at Cincinnati, Ohio, March, 1878.

The American Inventor, Vol. 1, page 112 *et seq.*, published at Cincinnati, Ohio, July 1878.

Boston Journal of Chemistry and Popular Science Review, Vol. 12, page 122 *et seq.*, published at Boston, Mass., May, 1878.

Boston Journal of Chemistry and Popular Science Review, Vol. 16, page 76 *et seq.*, published at Boston, Mass., July, 1882.

English Mechanic and World of Science, Vol. 26, page 265 *et seq.*, published at London, November 30, 1877, by Walter Sully.

English Mechanic and World of Science, Vol. 26, page 409 *et seq.*, published at London, January 4, 1878, by Walter Sully.

English Mechanic and World of Science, Vol. 26, page 427 *et seq.*, published at London, January 11, 1878, by Walter Sully.

English Mechanic and World of Science, Vol. 27, page 30 *et seq.*, published at London, March 22, 1878, by Walter Sully.

"*English Mechanic and World of Science*," Vol. 27, page 559 *et seq.*, published at London, September 6, 1878, by Walter Sully.

"*English Mechanic and World of Science*," Vol. 29,

page 155 *et seq.*, published at London, April 25, 1879, by Walter Sully.

Industrial News, Vol. 3, page 28 *et seq.*, published at New York, February, 1882, by the Inventors' Institute.

"Minutes of Proceedings of the Institution of Civil Engineers," Vol. 53, page 329 *et seq.*, published at London 1878, by the Institution of Civil Engineers.

Scientific and Literary Review and Journal of the Inventors' Institute, Vol. 13, page 85 *et seq.*, published at London, June, 1878.

Science News, Vol. I, page 202, *et seq.*, published at Salem, Mass., May 1, 1879.

"Transactions of the Royal Society of Edinburg," published at Edinburg, July 19, 1878.

"The Year Book of Facts in Science and the Arts," pages 86 and 88, published at London, 1878.

"Appleton's Cyclopædia of Applied Mechanics," page 531 *et seq.*, published at New York, 1879, by D. Appleton & Co.

The Advertiser, issue of May 9, 1878, published at Paris, France.

Daily Evening Traveler, issue of May 23, 1878, published at Boston, Mass.

Boston Courier, issue of June 2, 1878; published at Boston, Mass.

Boston Herald, issue of June 1, 1878, published at Boston, Mass.

Baltimore Daily News, issue of April 29, 1878, published at Baltimore, Md.

Baltimore American, issue of May 21, 1878, published at Baltimore, Md.

Boston Sunday Herald, issue of April 14, 1878, published at Boston, Mass.

The Clipper, issue of February 28, 1880, published at New York.

Cincinnati Commercial, issue of March 11, April 1, and May 5, 1878, published at Cincinnati, Ohio.

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Evening Journal, issue of May 9, 1878, published at Chicago, Ill.

Cape Ann Advertiser, issue of May 24, 1878, published at Cape Ann, Mass.

Dayton Democrat, issues of April 23 and May 11, 1878, published at Dayton, Ohio.

Daily News, issue of April 10, 1878, published at London.

London Daily Telegraph, issues of April 20 and May 22, 1878, published at London.

London Times, issues of January 17 and April 20, 1878, published at London.

London Morning Post, issue of April 20, 1878, published at London.

Evening Transcript, issue of May 23, 1878, published at Boston, Mass.

Boston Daily Globe, issue of May 24, 1878, published at Boston, Mass.

Boston Journal, issues of May 23, 25, and 30, 1878, published at Boston, Mass.

Boston Post, issue of May 24, 1878, published at Boston, Mass.

Boston Daily Advertiser, issue of May 24, 1878, published at Boston, Mass.

Frank Leslie's, issue of April 20, 1878, published at New York.

London Weekly Graphic, issue of March 16, 1878, published at London.

Lancaster Intelligencer, issue of February 25, 1878, published at Lancaster, Pa.

New York Mail, issue of April 26, 1878, published at New York.

Evening Post, issue of May 24, 1878, published at New York.

The Daily Fredonian, issues of May 27 and June 6, 1878, published at New Brunswick, N. J.

Evening Express, issue of March 20, 1878, published at New York.

The New York Sun, issues of April 28 and August 29, 1878, published at New York.

The World, issues of March 26, April 9, May 17 and May 31, 1878, published at New York.

The Weekly Sun, issue of February 27, 1878, published at New York.

New York Herald, issues of February 24, April 24 and April 28, 1878.

The Weekly Witness, issue of May 2, 1878, published at New York.

Newark Register, issues of May 3 and May 17, 1878, published at Newark, N. J.

The Daily Advertiser, issue of May 3, 1878, published at Newark, N. J.

Newark Evening Journal, issue of May 3, 1878, published at Newark, N. J.

New York Graphic, issues of March 15, April 2, April 18, June 8 and August 30, 1878, published at New York.

The Operator, issues of May 1 and June 1, 1878, published at New York.

The Public, issue of May 2, 1878, published at New York.

The Sunday Times, issue of April 7, 1878, published at Philadelphia, Pa.

Pottsville Miners' Weekly Journal, issue of April 12, 1878, published at Pottsville, Pa.

Philadelphia Inquirer, issue of April 20, 1878, published at Philadelphia, Pa.

Philadelphia Times, issue of March 9, 1878, published at Philadelphia, Pa.

Philadelphia Weekly Times, issue of April 27, 1878, published at Philadelphia, Pa.

Illustrated Police News, issue of May 24, 1878, published at New York.

Philadelphia Press, issue of March 9, 1878, published at Philadelphia, Pa.

Philadelphia Record, issues of March 9 and March 21, 1878, published at Philadelphia.

Philadelphia *Ledger*, issue of March 21, 1878, published at Philadelphia, Pa.

Portsmouth *Daily Chronicle*, issue of March 12, 1878, published at Portsmouth, N. H.

The State, issue of April 30, 1878, published at Richmond, Va.

Rochester *Democrat*, issue of March 13, 1878, published at Rochester, N. Y.

San Francisco *Chronicle*, issue of March 15, 1878, published at San Francisco, Cal.

St. Joseph *Daily Herald*, issue of May 23d, 1878, published at St. Joseph, Mo.

Washington Star, issues of April 19 and May 7, 1878, published at Washington, D. C., by the Evening Star Publishing Company.

"Workshop Receipts" (Third Series), page 172, published at London, in the year 1884, by E. & F. W. Spon.

"Engineering," Vol. 27, page 326 *et seq.*, published at London, April 18, 1879, edited by W. H. Maw and J. Dredge.

"Engineering," Vol. 27, page 202 *et seq.*, published at London, March 7, 1879, edited by W. H. Maw and J. Dredge.

Comptes Rendus, Vol. 85, page 1082, *et seq.*, deposited by Ch. Cros, April 30, 1877, descriptive of phonographs and their operation.

Scientific American, Vol. 37, page 304 *et seq.*, published at New York, November 17, 1877, by Munn & Co.

Scientific American, Vol. 39, page 118 *et seq.*, published at New York, August 24, 1878, by Munn & Co.

"Haslock's Metal Turning Handbook," published at London in the year 1882.

Telegraphic Journal, Vol. 7, page 53 *et seq.*, published at London, February 1, 1879, by Houghton & Co.

Telegraphic Journal, Vol. 7, page 151 *et seq.*, published at London, May 1, 1879, by Houghton & Co.

La Nature, issue of May 4, 1879, page 349 *et seq.*

Journal of the Society of Telegraph Engineers and Electricians, Vol. 8, page 303 *et seq.*, published at London, April 9, 1879.

"The Telephone, the Microphone, and the Phonograph," by Count Du Moncel, Chapter on Phonographs, pages 235 to 261, etc., published at New York, 1879, by Harper & Brothers.

Scribner's Monthly, Vol. 15, pages 857 *et seq.*, and 899 *et seq.*, published at New York, April, 1878, by Scribner & Co.

"Popular Science Review," Vol. 2, new series, page 219 *et seq.*, published at London, 1878.

"The Speaking Telephone, Talking Phonograph and Other Novelties," by George B. Prescott, Chapter 10, pages 292 to 308 *et seq.*, published at New York, 1878.

"Ganot's Elementary Treatise on Physics," pages 241, 242 and 243, published at New York, in the year 1883, by William Wood & Company.

"Elementary Treatise on Natural Philosophy," by A. Privat Deschanel, part 3, pages 824 and 815, published at London, in the year 1872, by Blackie & Son.

"Vorschule der Experimentalphysik," pages 263 to 266, *et seq.*, published at Leipzig, in the year 1883, by Duandt & Handel.

L'Architecte, issue of April 27, 1878, published in Paris, France, in 1878.

Le Monde Illustré, issue of April 6, 1878, published in Paris, France, in 1878.

"The Universal Engineer," issue of January 17, 1879, Vol. 2, page 33 *et seq.*, published in Manchester, England, edited by R. Z. Craven.

"The World's Weekly Review of Sciences," Vol. 47, pages 580 *et seq.*, published by Abbe Moigno, September-December, 1878.

Les Monde, issue of December 12, 1878, published in Paris, France.

Scientific American, issue of June 7, 1879, published in

the City of New York, New York. (See inter Div. page 356).

"Lehrbuch Der Physik und Meteorologie," by Dr. John Muller, sixth edition in 2 vols., (see page 229, of Vol. 2), published at Braunschweig, Germany, in the year 1868.

Le Moniteur Scientifique Journal Des Sciences Pures et Appliquees, 3 Series; Vol. VIII, pp. 460, 462, published at Paris, in 1878.

And also in other printed publications at present unknown to this defendant, but which he craves leave to add hereafter as he may be advised.

22. That for the purpose of deceiving the public the respective descriptions and specifications, filed by said respective applicants in the Patent Office of the United States during the pendency of the respective applications for the patents in suit, were made to contain less than the whole truth relative to the respective alleged inventions and discoveries.

23. That in view of the state of the art at and before the date of the alleged respective inventions of the said respective patentees, and of which due proof will be made by this defendant, the said letters patent in suit do not describe anything which is lawfully the subject-matter for a patent under the laws of the United States, or which involves patentable novelty.

24. This defendant, further answering, says, that by reason of the amendments, disclaimers and arguments, filed during the pendency of the respective applications for the said letters patent in suit, the said patents, and each of them, are narrowly limited, if they should be held to be valid at all, to specific and detailed constructions of apparatus described and claimed, and that said letters patent, and each of them, were issued with their respective claims as allowed, narrowly limited to the specific constructions of apparatus and parts claimed.

25. That the said Letters Patent in suit respectively, and claims thereof, claim more than was, or is, the invention of the respective patentees.

That the said Bell and Tainter are not and never were the joint inventors of the alleged invention described and claimed in Letters Patent, No. 341,214, and that said Sumner Tainter and Charles Sumner Tainter are not and never were the inventors respectively of the alleged inventions described and claimed in the said Letters Patent, No. 341,288 and No. 375,579, respectively.

26. And this defendant is advised and believes, and thereupon submits to this Honorable Court, that by reason of the foregoing facts, severally specified, the said Letters-Patent in suit, No. 341,214, No. 341,288 and No. 375,579, were and are null and void: and this defendant denies that he has ever infringed, or intended to infringe, or does now infringe, or threatens or intends to infringe, upon any of the rights of the complainant, and denies that he has realized or acquired any profits or gains whatsoever by reason of any infringements of any rights of the complainant, and denies that the complainant will be subject, as alleged, to great, irreparable damage or loss, or to any damage or loss whatsoever, if it does not obtain the relief sought and prayed for in its said Bill of Complaint.

27. In answer to the interrogatories propounded on page 11 of the said Bill of Complaint, this defendant would say:

"One.—This defendant has not made or sold any gramophones containing any of Complainant's said patented devices.

"Two.—This defendant has not made or sold any gramophone records containing any of complainant's said patented features."

28. And further answering, and not waiving any, but insisting upon all and singular the matters and things herein set forth, this defendant further says, by way of defence to the said Bill of Complaint, that this action is an attempt, under a cover of alleged infringement of certain patents alleged to belong to the complainant, to drive the said Berliner Gramophone Company and its representatives out of the business of manufacturing and selling Sound Recording and Reproducing Apparatus and records, which it has a perfect

right to make, sell and use under the sundry Letters Patent of the United States issued to Emile Berliner and Werner Suess, both of Washington, D. C., for sundry improvements relative to Sound Recording and Reproducing, among others, to wit, No. 272,786, dated November 8, 1887, No. 382,490, dated May 15, 1888, and No. 524,543, dated February 19, 1895.

This defendant further answering says that by virtue of certain agreement of license the said Berliner Company, of which he is President, has been selling to the public the Sound Reproducing Machine, known, commercially, as the Berliner Gramophone, and Berliner records therefor, for the past three or four years to the extent of many hundreds of thousands, and has built up a large trade; that in the year 1898 the public has paid for said Gramophone apparatus amounts approximating three-quarters of a million of dollars.

That the said Berliner Gramophone is a radically different type of apparatus and operated upon a radically different principle from the apparatus described and claimed in the respective patents in suit, and has always been so recognized by the trade and the public at large, as well as by experts and professional men.

And this defendant further avers that it was so recognized as long ago as 1891 by one of complainant's counsel in this case, who, in a written opinion given to Mr. Berliner at that time, counselled and advised him that the said apparatus, commercially known as the Gramophone, can be used in this country without infringement of any existing and valid patent, emphasizing the marked distinctions and differences between the Berliner Gramophone and the apparatus and method of Bell and Tainter.

That not until suit was brought when the said large trade was built up by the said Berliner Gramophone Company, and the superiority of the Gramophone as a commercial apparatus was so generally and publicly recognized over all other sound recording and reproducing apparatus,

including the complainants, did complainants ever make any claim to defendants that their machine or apparatus, or any part thereof, infringed any of the alleged inventions of the patents in suit, or any other of their inventions; and this defendant avers that the present is an unjust attempt on the part of the complainant to injure the Berliner Company's legitimate trade and business.

29. This defendant further answering says and avers that should an injunction issue, as prayed in the said Bill of Complaint, the said defendants will suffer thereby great and irreparable damage and injury; that the complainant has already, by means of threatening, unfair and unjust circulars, letters and advertisements issued and published by it and circulated amongst the defendant's customers and the trade and public generally, greatly injured and damaged defendant company's business and trade, said threatening communications illegally and unjustly notifying defendant's customers and the public generally that defendant's machines and apparatus are made, sold and used in violation of complainant's said patents and are infringements thereof, and that all who sell or use the same will be held as infringers and legally proceeded against by the said complainant to the great and irreparable damage, loss and injury of the said defendants, and the said defendant prays that the said complainant be enjoined and estopped from continuing the issue of such threatening and damaging communications, advertisements, etc. This defendant denies, as he has before denied, that the complainant has suffered or will suffer any damage or injury whatsoever by reason of any act or acts of this defendant in the premises.

All of which things this defendant is ready and willing to aver, maintain and prove as this Honorable Court shall direct.

This defendant prays the benefit of all the matters and things hereinbefore set forth and alleged, as if the same were specially pleaded where a plea would have been proper, or, as, if on account thereof, he had demurred to

the said Bill of Complaint, or to part or parts thereof, where a demurrer would have been proper; without this, that any other matter or thing in the complainant's Bill contained, material or effectual to be answered, traversed, confessed and avoided, or denied, is true, all of which things this defendant will maintain and prove as this Honorable Court shall direct.

And humbly prays to be hence dismissed with his reasonable costs and charges in this behalf most wrongfully sustained.

HORACE PETTIT,

*Solicitor and of Counsel for Thomas S. Parvin,
Defendant.*

March 6th, 1899.

IN THE
Circuit Court of the United States,
EASTERN DISTRICT OF PENNSYLVANIA.

October Sessions, 1898. No. 34.

IN EQUITY.

AMERICAN GRAPHOPHONE COMPANY,
Complainant,
vs.

BERLINER GRAMOPHONE COMPANY, THOMAS
S. PARVIN, AND E. R. JOHNSON,
Defendants.

The Answer of Eldridge R. Johnson, one of the above-named defendants, to the Bill of Complaint of the American Graphophone Company, the above-named complainant.

This respondent now and at all times hereafter saving and reserving to himself any and all manner of benefit or advantage of exceptions, or otherwise, that can or may be had to the many errors, uncertainties and imperfections in the said Bill of Complaint contained, for answer to said Bill, or so much thereof as the defendant is advised is material or necessary for him to make answer unto, answering says:

Whether the said complainant, the American Graphophone Company, is a corporation duly organized and existing

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under the laws of the State of West Virginia this defendant does not know save by information contained in said Bill of Complaint, and calls upon said complainant for proof thereof.

1. This defendant denies that Chichester A. Bell and Sumner Tainter were the original, first or joint inventors of the alleged improvements in recording and reproducing speech and other sounds referred to in paragraph 1 of the Bill of Complaint, and denies that the same were not known or used by others in this country before the date of their alleged invention by the said Bell and Tainter, and denies that they were not patented or described in any printed publications in this or any foreign country before the invention of the said Bell and Tainter, and denies that they were not in public use or on sale in the United States for more than two years prior to the date of the application of the said Bell and Tainter for a patent therefor, and denies that the same had not been abandoned to the public.

2. This defendant believes and admits that certain Letters Patent of the United States, No. 341,214, dated May 4, 1886, were issued to the said Chichester A. Bell and Sumner Tainter for certain alleged Improvements in Recording and Reproducing Speech and other Sound, but denies that the said Bell and Tainter in making application therefor complied in all respects with the provisions and requirements of the laws of the United States in such case made and provided; and denies that any valid, exclusive rights were acquired by virtue of the issue of the said Letters Patent.

3. This defendant denies that the said Sumner Tainter was the original, first and sole inventor of the alleged improvement in Apparatus for Recording and Reproducing Sounds or Sonorous Vibrations, as averred in paragraph 3 of the Bill of Complaint, and denies that the said alleged invention was not known or used by others in this country, or patented or described in any printed publication in this or any foreign country prior to the date of the alleged invention of the said Tainter, and denies that the same was not in public

use or on sale in the United States for more than two years prior to the application for Letters Patent therefor; and denies that the same has not been abandoned to the public.

4. This defendant believes and admits that certain Letters Patent of the United States, No. 341,288, dated May 4, 1886, were issued to the said Sumner Tainter for certain alleged Improvement in Recording and Reproducing Sound, but denies that the said Tainter in making application therefor fully complied with the provisions and requirements of the laws of the United States in such cases made and provided; and denies that any valid, exclusive rights were acquired by virtue of the issue of said Letters Patent.

5. This defendant denies that the said Charles Sumner Tainter was the original, sole and first inventor of the alleged Improvement in Apparatus for Recording and Reproducing Speech and other Sound referred to in paragraph 5 of the Bill of Complaint; and denies that the said invention was not known and used by others in this country, or patented or described in any printed publication in this or any foreign country before the date of the alleged invention of the said Tainter, and denies that the same was not in public use or on sale in the United States for more than two years prior to the date of the application for the said Letters Patent; and denies that the same was not abandoned to the public.

6. This defendant believes and admits that certain Letters Patent of the United States, No. 375,579, dated December 27, 1887, were issued to the said Charles Sumner Tainter for certain alleged Improvements in Apparatus for Recording and Reproducing Speech and other Sounds, but denies that the said Charles Sumner Tainter in making application therefor fully complied with the requirements and provisions of the laws of the United States in such case made and provided, and denies that any valid exclusive rights were acquired by virtue of the issue of said Letters Patent.

7. This defendant denies that the said alleged inventions and improvements described in the said Letters Patent No. 341,214, No. 341,288, and No. 375,579, were designed for or are capable of conjoint use in the legal sense of the term, and denies that they are thus conjointly used by defendants.

8. This defendant does not know and has no information, save by said Bill of Complaint, whether said Letters Patent No. 341,214 were assigned by the said Bell and Tainter to the Volta Graphophone Company, as alleged in paragraph 8 of the Bill of Complaint, and calls upon the complainant for proof thereof.

9. This defendant does not know and has no information, save by said Bill of Complaint, whether said Letters Patent No. 341,288, were duly assigned by the said Sumner Tainter to the said Volta Graphophone Company, and calls upon the complainant for proof thereof.

10. This defendant does not know and has no information, save by said Bill of Complaint, whether said Letters Patent No. 375,579, were duly assigned by the said Charles Sumner Tainter to the said Volta Graphophone Company, and calls upon the complainant for proof thereof.

11. This defendant does not know and has no information, save by said Bill of Complaint, whether said Letters Patent No. 341,214, No. 341,288 and No. 375,579, or any of them, were duly assigned unto the complainant, the American Graphophone Company, by the said Volta Graphophone Company, and calls upon the complainant for proof thereof.

12. This defendant denies that he has ever made, sold or used, directly or indirectly, any constructions or devices which infringe any of the claims of any of the said Letters Patent hereinbefore referred to; and denies that the complainant is now, or ever was, the sole and exclusive owner of any rights acquired under or by virtue of the said Letters Patent, or otherwise, which this defendant has infringed.

13. This defendant denies that the complainant has expended large sums of money in practicing and introducing to the public any invention or improvement which this defendant has made, sold or used, directly or indirectly, and denies that there has been any public acquiescence that Bell and Tainter were the first original inventors of the devices and constructions which the complainants by the said Bill of Complaint claim broadly were the inventions of the said Bell and Tainter, and denies that the said patents are good and valid patents; and this defendant denies that the public have acknowledged these claims of the complainant to the exclusive right to the said alleged inventions under the said patents; and this defendant denies that he has done or performed any acts, directly or indirectly, which have infringed or interfered with any rights of the complainant in the premises.

14. This defendant is informed and believes that the said complainant did file a Bill of Complaint in the United States Circuit Court for the Southern District of New York, to enjoin the manufacture, use and sale of a machine known as the "Metaphone," and that the Court, in a decision by Judge SHIPMAN (87 Fed. Rep., 873), held that the said "Metaphone," as an organized whole, infringed claims 19 to 24 of Letters Patent No. 341,214; but this defendant avers that the said "Metaphone" embodies a construction and combination relative to the said claims which is absolutely and totally dissimilar from the construction and operation of any machine or device which this defendant has made, used or sold, directly or indirectly, and he is informed and believes that the decision of Judge SHIPMAN relative to the said "Metaphone" has no application whatsoever to any device that this defendant has ever made, used or sold; and this defendant is informed and believes that the construction given by Judge SHIPMAN to the said claims would positively preclude their application to any device or combination of parts which this defendant may have at any time made, sold or used.

15. This defendant denies that he, the said E. R. John-

son, has made, or caused to be made, sold or used apparatus, or parts of apparatus, adapted or intended to be used for recording and reproducing speech or other sounds substantially as described and claimed in said Letters Patent, No. 341,214, No. 341,288 or No. 375,579; and denies that any other party, or parties, have concerted or acted with him in any infringement of, or attempt to infringe, the said Letters Patent, as alleged in the said Bill of Complaint; and denies that he has sold, or delivered to the said Berliner Gramophone Company, or to Thomas S. Parvin, or either of them, at any time any devices such as described and claimed in any of the said Letters Patent, or any parts of such devices for any purpose whatsoever. This defendant denies that he has sold or delivered to the said Berliner Company, or to Thomas S. Parvin, or to any other parties; part or parts of devices with the purpose or intent that the same should be assembled in a complete device such as described or claimed in any of the said Letters Patent in suit; and this defendant denies that he has in any manner infringed any of the said Letters Patent, or has done any acts whatsoever with the intent to injure the complainant, or to deprive it of any just profits to which it might be entitled, from or arising out of the said patents in suit, or any of them.

This defendant denies that he has conspired or concerted with any party or parties in any infringement of, or in any attempt to infringe, directly or indirectly, any of the rights of this complainant under or by virtue of the said letters patent in suit, or any of them; and denies that he has threatened individually, or in concert with others, directly or indirectly to so infringe any of the rights of this complainant in the premises; and denies that the complainant, by any acts of this defendant, or any acts of these defendants, has suffered any irreparable loss or injury, or any loss or injury whatsoever; and denies that this complainant has by any unlawful act of this defendant, or any of these defendants, been deprived of any gains or profits whatsoever; and this defendant denies that he, or any of the said defendants, have ever received or derived, or are receiving or deriving any gains or profits whatsoever by reason of any infringement of the rights of the complainant in the premises, or otherwise.

16. This defendant denies that he has by any acts whatsoever encouraged or induced others to infringe the said Letters Patent in suit, or any of them.

17. This defendant denies that he was duly notified by complainant of the alleged infringement complained of in said Bill of Complaint, and denies that he refused to desist from any infringement of any rights of the complainant in the premises.

This defendant avers that the complainant has wholly failed to comply with the requirements of Section 4909 of the Revised Statutes of the United States, in that it has wholly failed to give public notice of the fact of the issue of the said respective Letters Patent, or of the number or date of the same of any claim it had, or pretended to have had, or to have, to the exclusive use of the said respective alleged inventions by virtue of the said respective Letters Patent in suit, or otherwise, by marking, stamping, or otherwise affixing notice to said respective alleged patented improvements, in suit as made, sold or used by the complainant; but that it has failed to mark the said alleged patented improvements as required by said Section of the Revised Statutes.

This defendant, further answering, and not waiving any, but insisting upon all and singular the matters herein set forth, further says by way of defense to the said Bill of Complaint, upon information and belief, that the said Letters Patent in suit, and each of them, are null and void, for the reasons as follows, to wit:

18. That the said Chichester A. Bell and Sumner Tainter, the alleged joint inventors of the alleged Improvements in Recording and Reproducing Speech and other Sounds, described and claimed in said Letters Patent No. 341,214, were not the true, original or first inventors or discoverers, or joint inventors or discoverers, of the said alleged Improvement described in the said Letters Patent, nor of any material or substantial part thereof, but that the thing patented in the said Letters Patent No. 341,214 was prior to the alleged invention or discovery of the said Bell and Tainter known to

and used by the hereinafter mentioned persons at the hereinafter mentioned places, respectively.

That the said Sumner Tainter, the alleged inventor of the Apparatus for Recording and Reproducing Sounds, described and claimed in Letters Patent No. 341,288, was not the true, original or first inventor or discoverer of the said alleged improvement described and claimed in said Letters Patent, nor of any material or substantial part thereof, but that the thing patented in the said Letters Patent No. 341,288 was prior to the alleged invention or discovery of the said Tainter, known to and used by the hereinafter mentioned persons at the hereinafter mentioned places, respectively.

That the said Charles Sumner Tainter, the alleged inventor of the Apparatus for Recording and Reproducing Speech and other Sounds, described and claimed in the said Letters Patent, No. 375,579, was not the true, original or first inventor, or discoverer, of the said alleged Improvement described and claimed in said Letters Patent, nor of any material or substantial part thereof, but that the thing patented in the said Letters Patent, No. 375,579, was prior to the alleged invention or discovery of the said Charles Sumner Tainter known to and used by the hereinafter mentioned persons at the hereinafter mentioned places, respectively, to wit:

Thomas A. Edison, of Llewellyn Park, New Jersey, at Menlo Park, New Jersey, and elsewhere.

Emile Berliner, of Washington, D. C., at Washington, D. C., and elsewhere.

John F. Ott, of Orange, New Jersey, at Menlo Park, Orange, New Jersey, and elsewhere.

Edward H. Johnson, of Greenwich, Connecticut, at Menlo Park, New Jersey, New York, New York, and elsewhere.

Charles Batchelor, of New York, New York, at Menlo Park, New Jersey, New York, New York, and elsewhere.

John Kruesi, Schenectady, New York, at Menlo Park, New Jersey, New York, New York, and elsewhere.

James U. McKenzie, of Brooklyn, New York, at Menlo Park, New Jersey, New York, New York, and elsewhere.

George H. Harrington, of Wichita, Kansas, at Wichita, Kansas, and elsewhere.

Frank Lambert, of Brooklyn, New York, at Ansonia, Connecticut, Jamaica, Brooklyn, and New York, New York, and elsewhere.

Eugene Pastre, of Brooklyn, New York, at Ansonia, Connecticut, at Jamaica, Brooklyn, and New York, New York, and elsewhere.

Walter D. Davis, of Brooklyn, New York, at Ansonia, Connecticut, Jamaica, Brooklyn, and New York, New York, and elsewhere.

Isaac W. Heysinger, of Philadelphia, Pennsylvania, at Philadelphia, Pennsylvania, and elsewhere.

Ansonia Clock Co., of Ansonia, Connecticut, at Ansonia, Connecticut, and elsewhere.

Clarence J. Blake, of Boston, Massachusetts, at Boston, Massachusetts, Washington, D. C., and elsewhere.

Clarence E. Gifford, of Jamestown, New York, at Jamestown, New York, Chicago, Illinois, Lewiston, Pennsylvania, and elsewhere.

Sigmund Bergmann, of New York, New York, at New York, New York, Menlo Park, New Jersey, and elsewhere.

Theodore W. Searing, of South Norwalk, Connecticut, at New York, New York, and elsewhere.

C. H. Field, of Providence, Rhode Island, at Providence, Rhode Island, and elsewhere.

O. H. Bogardus, of Syracuse, New York, at Syracuse, New York, and elsewhere.

Theodore Cooper, Crompton Mills, Warwick, Rhode Island, at Crompton Mills, Warwick, and Providence, Rhode Island, and elsewhere.

R. Kennedy, of Mt. Carmel, Connecticut, at Mt. Carmel, Connecticut, and elsewhere.

Ralph S. Mershom, of Zanesville, Ohio, at Zanesville, Ohio, and elsewhere.

L. Hillman, of Newtown, New Jersey, at Newtown, New Jersey, and elsewhere.

Frederick D. Miles, of Philadelphia, Pennsylvania, at Philadelphia, Pennsylvania, and elsewhere.

James M. Connor, of Brooklyn, New York, at Brooklyn, New York, and elsewhere.

George R. Babbitt, of Providence, Rhode Island, at Providence, Rhode Island, and elsewhere.

John C. Guerrant, of Danville, Virginia, at Danville, Virginia, and elsewhere.

Robert B. Atchison, of Boston, Massachusetts, at Boston, Massachusetts, and elsewhere.

Loring Pickering, of San Francisco, California, at San Francisco, California, and elsewhere.

A. Wilford Hall, of New York, New York, at New York, New York, and elsewhere.

Thomas L. Lagers, of Philadelphia, Pennsylvania, at Philadelphia, Pennsylvania, and elsewhere.

Milton Bradley, of Springfield, Massachusetts, at Springfield, Massachusetts, and elsewhere.

Robert N. Lockwood, of New York, at New York, New York, and elsewhere.

William A. Leggo, of New York, New York, at New York, New York, and elsewhere.

A. S. Nichols, of New Haven, Connecticut, at New Haven, Connecticut, and elsewhere.

J. Harris Rogers, of Washington, D. C., at Washington, D. C., and elsewhere.

James Webb Rogers, of New York, New York, at New York, New York, and elsewhere.

Christopher C. Reynolds, of Prescott, Arizona, at Prescott, Arizona, and elsewhere.

John Absterdam, of New York, New York, at New York, and elsewhere.

Rufus Anderson, of New York, New York, at New York, New York, Danville, Pa., and elsewhere.

Seth E. Beedy, of Farmington, Maine, at Farmington, Maine, and elsewhere.

John J. Linscott, of Farmington, Maine, at Farmington, Maine, and elsewhere.

Collett Leventhorpe, of Rutherfordton, North Carolina, at Rutherfordton, North Carolina, and elsewhere.

Samuel H. Bartlett, of New York, New York, at New York, New York, and elsewhere.

Also to others, whose names and residences and places of prior knowledge and use are at present unknown to this defendant, but which he craves leave to hereafter add as he may be advised.

19. That the things patented in the said Letters Patent No. 341,214, and in No. 341,288 and in No. 375,579, were in public use and on sale in the United States for more than two years prior to the respective dates of the respective applications for said Letters Patent in suit, and that such use and sale was had by the foregoing named persons at the foregoing named places, respectively.

20. That the thing patented in the said Letters Patent, No. 341,214, had prior to the alleged invention or discovery thereof of said Bell and Tainter been patented and described in the hereinafter mentioned Letters Patent of the United States and foreign countries.

That the thing patented in the said Letters Patent, No. 341,288, had prior to the alleged invention or discovery of said Sumner Tainter been patented and described in the hereinafter mentioned Letters Patent of the United States and foreign countries.

21. That the thing patented in the said Letters Patent No. 375,579, had prior to the alleged invention or discovery of the said Charles Sumner Tainter been patented and described in the hereinafter mentioned Letters Patent of the United States and foreign countries:

Number.	Date.	Patentee.
17,146	April 28, 1857	Charles H. Field,
32,959	July 30, 1861	O. H. Bogardus.
52,292	January 30, 1866	T. Kennedy.
56,141	July 3, 1866	Theodore Cooper.
72,521	December 24, 1867	Ralph S. Mershom.
93,619	August 10, 1869	L. Hillman.
115,934	June 13, 1871	James M. Connor.
111,859	February 14, 1871	Frederick B. Miles.
153,212	July 21, 1874	George R. Babbitt.
174,715	March 14, 1876	Robert R. Atchison.
183,920	October 31, 1876	John C. Guerrant.
191,464	May 29, 1877	Loring Pickering.
200,521	February 10, 1878	Thomas A. Edison.
201,760	March 26, 1878	Thomas A. Edison.
213,554	March 25, 1879	Thomas A. Edison.
219,939	September 23, 1879	A. Wilford Hall.
222,292	December 2, 1879	Thomas L. Luders.
225,457	March 16, 1880	Milton Bradley.
227,679	May 18, 1880	Thomas A. Edison.
231,065	August 10, 1880	Robert M. Lockwood, <i>et al.</i>
232,978	October 5, 1880	John W. Kenyon.
238,929	March 15, 1881	William A. Leggo.
266,746	October 31, 1882	Seth E. Beedy.
271,908	February 6, 1883	A. S. Nichols.
277,349	May 8, 1883	J. Harris Rogers.
279,292	June 12, 1883	James H. M. Waldorp.
283,665	August 21, 1883	James W. Rogers.
287,166	October 23, 1883	Christopher C. Reynolds.
295,219	March 18, 1884	John Absterdam.
296,376	April 8, 1884	Rufus Anderson.
293,030	May 6, 1884	Albert Schmid.
305,178	September 16, 1884	George M. Guerrant, <i>et al.</i>
341,212	May 4, 1886	A. G. and C. A. Bell.
341,287	May 4, 1886	Sumner Tainter.
372,786	November 8, 1887	Emile Berliner.
12,192	January 9, 1855	W. J. Casselman.

Letters Patent of Great Britain, as follows:

Name.	Number.	Date.
William Mann	1912	1857
Aime L. E. Briettmayer	324	1860
Henry B. Greenwood	325	1870
Thomas A. Edison	2909	1877
Thomas A. Edison	1644	1878
Herbert J. Haddon	291	1882

Letters Patent of France, as follows:

Thomas A. Edison	121,687	February 19, 1878
Patent of Addition thereto		February 19, 1878
Thomas A. Edison	129,974	September 16, 1878
Charles Cros	124,213	July 27, 1878
Patent of Addition thereto		October 3, 1878
Antonio Vicini	128,215	March 17, 1879
Charles Weyher	135,688	May 20, 1880
Patent of Addition thereto		March 23, 1880
Patent of Addition thereto		July 11, 1880
Patent of Addition thereto		September 20, 1883
Paul Goloubitzky	145,584	December 7, 1881
Patent of Addition thereto		March 15, 1882
Patent of Addition thereto		September 26, 1882
Patent of Addition thereto		September 20, 1883
Morel	146,670	March 17, 1882
Morel	146,673	March 17, 1882
Claude A. Terrier	156,749	November 8, 1883

Letters Patent of Germany as follows:

Thomas A. Edison	12,631	July 12, 1878
Kleist & Company	11,053	January 24, 1879
Thomas A. Edison	14,308	August 18, 1881
Thomas A. Edison	12,631	April 27, 1881

Letters Patent of Canada as follows:

Thomas A. Edison	8026	October 17, 1877
		Issued Oct. 20, 1877
Thomas A. Edison	9282	October 19, 1878.

Also the following Letters Patent granted to Thomas A. Edison in the countries named, to wit :

Belgium, No. 43,984, dated January 31, 1878, and No. 45,375, dated June 29, 1878.

Italy, No. 422, dated February 8, 1878, and No. — dated July 4, 1878.

Austria, dated January 1, 1879, and dated January 8, 1879.

Spain, dated May 6, 1878.

Russia, No. 1161, dated February 15/27, 1882.

Norway, dated October 8, 1878.

Sweden, dated March 29, 1879.

Denmark, No. 1345, dated October 31, 1878.

India, deposited March 20, 1879.

New South Wales, dated September 16, 1878.

Victoria, dated August 13, 1878, and No. 2549, dated August 15, 1878.

That the thing patented in the said several Letters Patent in suit, No. 341,214, No. 341,288 and No. 375,579, and all material and substantintial parts thereof had prior to the date of the alleged invention and discovery of the said Bell and Tainter been fully and accurately described and published in the following printed publications, to wit :

Chemical News and Journal of Physical Science, Vol. 37, page 99, *et seq.*, published at London, March 8, 1878, by William Crookes.

Chambers' Journal, Vol. 55, page 126, *et seq.*, published at London and Edinburg, February 23, 1878, by W. and R. Chambers.

Chambers' Journal, Vol. 55, page 206, *et seq.*, published at London and Edinburg, March 30, 1878, by W. and R. Chambers.

Chambers' Journal, Vol. 55 page 256, *et seq.*, published at London and Edinburg, April 20th, 1878, by W. and R. Chambers.

Engineering, Vol. 25, page 187 *et seq.*, published at London March 8, 1878, edited by W. H. Maw and J. Dredge.

The Engineer, Vol. 46, page 84 *et seq.*, published at London, Aug. 2, 1878, by George Leopold Riche.

The Engineer, Vol. 56, page 283 *et seq.*, published at London, October 19, 1883, by George Leopold Riche.

The Gentlemen's Magazine, Vol. 20, New Series, page 688 *et seq.*, published at London, June, 1878, by Chatto and Windus.

Harper's New Monthly Magazine, Vol. 57, page 312 *et seq.*, published at New York, July, 1878, by Harper & Brothers.

Harper's New Monthly Magazine, Vol. 57, page 470 *et seq.*, published at New York, August, 1878, by Harper & Brothers.

Harper's New Monthly Magazine, Vol. 57, page 632 *et seq.*, published at New York, September 1878, by Harper & Brothers.

Harper's Weekly, Vol. 22, page 249 *et seq.*, published at New York, March 30, 1878, by Harper & Brothers.

Iron, Vol. 2, page 301 *et seq.*, published at London, March 9, 1878, by *Iron* offices.

Iron Age, page 27 *et seq.*, of issue of June 27, 1878, published at New York by David Williams.

Iron Age, page 24 *et seq.*, of issue of March 28, 1878, published at New York by David Williams.

Iron Age, page 5 *et seq.*, of issue of May 23, 1878, published at New York by David Williams.

Iron Age, page 8 *et seq.*, of August 22, 1878, published at New York by David Williams.

Journal of the Society of Telegraph Engineers and Electricians, Vol. 7, page 68 *et seq.*, published at London, February 27, 1878, by E. and F. W. Spon.

Journal of the Franklin Institute, Vol. 75, page 266 *et seq.*, published at Philadelphia, April, 1878, by the Franklin Institute.

Journal of the Franklin Institute, Vol. 75, page 348 *et seq.*, published at Philadelphia, May, 1878, by the Franklin Institute.

Journal of the Franklin Institute, Vol. 84, page 49 *et seq.*, published at Philadelphia, July, 1882, by the Franklin Institute.

Journal of the Society of Arts, Vol. 26, page 109 *et seq.*, published at London, January 11, 1878, by George Bell & Sons.

Journal of the Society of Arts, Vol. 26, page 241 *et seq.*, published in London, February 15, 1878, by George Bell & Sons.

Journal of the Society of Arts, Vol. 26, page 543 *et seq.*, published at London, May 10, 1878, by George Bell & Sons.

"Knight's New Mechanical Dictionary," page 671 *et seq.*, published at Boston in the year 1884, by Houghton, Mifflin & Co.

Manufacturer and Builder, Vol. 10, page 84 *et seq.*, published in New York, April, 1878, by H. N. Black.

Manufacturer and Builder, Vol. 11, page 95 *et seq.*, published at New York, April, 1879, by H. N. Black.

Mechanics, Vol. 5, page 319 *et seq.*, published at New York, April 26, 1884.

Nature, Vol. 17, page 90 *et seq.*, published at London and New York, November 29, 1877, by Macmillan & Co.

Nature, Vol. 17, page 190 *et seq.*, published at London and New York, January 3, 1878, by Macmillan & Co.

Nature, Vol. 17, page 291 *et seq.*, published at London and New York, February 7, 1878, by Macmillan & Co.

Nature, Vol. 17, page 415 *et seq.*, published at London and New York, March 21, 1878, by Macmillan & Co.

Nature, Vol. 17, page 384 *et seq.*, published at London, and New York, March 17, 1878, by Macmillan & Co.

Nature, Vol. 17, page 423 *et seq.*, published at London and New York, March 28, 1878, by Macmillan & Co.

Nature, Vol. 17, page 471 *et seq.*, published at London and New York, April 11, 1878, by Macmillan & Co.

Nature, Vol. 18, pages 38 and 39 *et seq.*, published at London and New York, May 9, 1878, by Macmillan & Co.

Nature, Vol. 18, pages 93 and 101 *et seq.*, published at London and New York, May 23, 1878, by Macmillan & Co.

Nature, Vol. 18, page 117 *et seq.*, published at London and New York, May 30, 1878, by Macmillan & Co.

Nature, Vol. 18, page 168 *et seq.*, published at London and New York, June 13, 1878, by Macmillan & Co.

Nature, Vol. 18, page 240 *et seq.*, published at London and New York, June 27, 1878, by Macmillan & Co.

Nature, Vol. 18, page 249 *et seq.*, published at London and New York, July 4, 1878, by Macmillan & Co.

Nature, Vol. 18, page 320 *et seq.*, published at London and New York, July 18, 1878, by Macmillan & Co.

Nature, Vol. 18, 340 *et seq.*, published at London and New York, July 25, 1878, by Macmillan & Co., and Vol. 18, page 349, August 8, 1878.

Nature, Vol. 18, page 454 *et seq.*, published at London and New York, August 22, 1878, by Macmillan & Co.

Nature, Vol. 19, page 122 *et seq.*, published at London and New York, December 12, 1878, by Macmillan & Co.

Nature, Vol. 19, page 374 *et seq.*, published at London and New York, February 25, 1879, by Macmillan & Co.

Nature, Vol. 23, page 373 *et seq.*, published at London and New York, February 17, 1878, by Macmillan & Co.

Nature, Vol. 23, page 441 *et seq.*, published at London and New York, March 10, 1881, by Macmillan & Co.

Nature, Vol. 29, page 460, *et seq.*, published at London and New York, March 13, 1884, by Macmillan & Co.

The New York Times, published at New York City, issue of March 24, 1878.

The New York Times, published at New York City, issue of April 20, 1878.

The New York Times, published at New York City, issue of April 21, 1878.

The New York Times, published at New York City, issue of June 9, 1878.

The New York Times, published at New York City, issue of February 1, 1880.

The New York Tribune, published at New York City, issue of December 26, 1877.

The New York Tribune, published at New York City, issue of January 18, 1878.

The New York Tribune, published at New York City, issue of March 21, 1878.

The New York Tribune, published at New York City, issue of March 25, 1878.

The New York Tribune, published at New York City, issue of April 6, 1878.

The New York Tribune, published at New York City, issue of April 20, 1878.

North American Review, Vol. 126, page 527, *et seq.*, published at New York, May-June, 1878, by D. Appleton & Co.

Popular Science Monthly, Vol. 12, pages 719 *et seq.* and 748 *et seq.*, published at New York, April, 1878, by D. Appleton & Co.

Quarterly Journal of Science, Vol. 8, New Series (Vol. 15, Old Series), page 245 *et seq.*, published at London, 1878, at offices of the *Quarterly Journal of Science*.

Scientific American, Vol. 37, page 376, published at New York, December 18, 1877, by Munn & Co.

Scientific American, Vol. 37, page 384 *et seq.*, published at New York, December 12, 1877, by Munn & Co.

Scientific American, Vol. 38, page 3 *et seq.*, published at New York, January 5, 1878, by Munn & Co.

Scientific American, Vol. 38, page 86 *et seq.*, published at New York, February 3, 1878, by Munn & Co.

Scientific American, Vol. 38, page 384 *et seq.*, published at New York, June 23, 1878, by Munn & Co.

Scientific American, Vol. 38, page 405 *et seq.*, published at New York, June 29, 1878, by Munn & Co.

Scientific American, Vol. 40, page 356 *et seq.*, published at New York, June 7, 1878, by Munn & Co.

Scientific American, Vol. 39, page 5 *et seq.*, published at New York, July 6, 1878, by Munn & Co.

Scientific American, Vol. 39, page 17 *et seq.*, published at New York, July 13, 1878, by Munn & Co.

Scientific American Supplement, page 1828, *et seq.*, published at New York, March 16, 1878, by Munn & Co.

Scientific American Supplement, page 1893, *et seq.*, published at New York, April 13, 1878, by Munn & Co.

Scientific American Supplement, page 1904, *et seq.*, published at New York, April 20, 1878, by Munn & Co.

Scientific American Supplement, page 1973 *et seq.*, published at New York, May 18, 1878, by Munn & Co.

Scientific American Supplement, page 2187, *et seq.*, published at New York, August 24, 1878, by Munn & Co.

Scientific American Supplement, page 3454 *et seq.*, published at New York, February 28, 1880, by Munn & Co.

Scientific American Supplement, page 2113 *et seq.*, published at New York, July 20, 1878, by Munn & Co.

The Telegraphic Journal and Electrical Review, Vol. 6, page 6 *et seq.*, published at London, January 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 182 *et seq.*, published at London, May 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 250 *et seq.*, published at London, June 15, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 53 *et seq.*, published at London, February 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 142 *et seq.*, published at London, April 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 275 *et seq.*, published at London, July 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 317 *et seq.*, published at London, August 1, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 6, page 385 *et seq.*, published at London, September 15, 1878, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 7,

page 53 *et seq.*, published at London, February 1, 1879, by Houghton & Company.

The Telegraphic Journal and Electrical Review, Vol. 7, page 233 *et seq.*, published at London, July 15, 1878, by Houghton & Co.

Western Review, Vol. 1, page 681 *et seq.*, published at Kansas City, Mo., January, 1878.

Western Review, Vol. 2, page 256 *et seq.*, published at Kansas City, Mo., July, 1878.

Annual Report of Science and Industry, Vol. 7, page 399, *et seq.*, published at New York, 1877.

The American Inventor, Vol. 1, page 42 *et seq.*, published at Cincinnati, Ohio, March, 1878.

The American Inventor, Vol. 1, page 112 *et seq.*, published at Cincinnati, Ohio, July 1878.

Boston Journal of Chemistry and Popular Science Review, Vol. 12, page 122 *et seq.*, published at Boston, Mass., May, 1878.

Boston Journal of Chemistry and Popular Science Review, Vol. 16, page 76 *et seq.*, published at Boston, Mass., July, 1882.

English Mechanic and World of Science, Vol. 26, page 265 *et seq.*, published at London, November 30, 1877, by Walter Sully.

English Mechanic and World of Science, Vol. 26, page 409 *et seq.*, published at London, January 4, 1878, by Walter Sully.

English Mechanic and World of Science, Vol. 26, page 427 *et seq.*, published at London, January 11, 1878, by Walter Sully.

English Mechanic and World of Science, Vol. 27, page 30 *et seq.*, published at London, March 22, 1878, by Walter Sully.

"English Mechanic and World of Science," Vol. 27, page 559 *et seq.*, published at London, September 6, 1878, by Walter Sully.

"English Mechanic and World of Science," Vol. 29,

page 155 *et seq.*, published at London, April 25, 1879, by Walter Sully.

Industrial News, Vol. 3, page 28 *et seq.*, published at New York, February, 1882, by the Inventors' Institute.

"Minutes of Proceedings of the Institution of Civil Engineers," Vol. 53, page 329 *et seq.*, published at London 1878, by the Institution of Civil Engineers.

Scientific and Literary Review and Journal of the Inventors' Institute, Vol 13, page 85 *et seq.*, published at London, June, 1878.

Science News, Vol. I, page 202, *et seq.*, published at Salem, Mass., May 1, 1879.

"Transactions of the Royal Society of Edinburg," published at Edinburg, July 19, 1878.

"The Year Book of Facts in Science and the Arts," pages 86 and 88, published at London, 1878.

"Appleton's Cyclopædia of Applied Mechanics," page 531 *et seq.*, published at New York, 1879, by D. Appleton & Co.

The Advertiser, issue of May 9, 1878, published at Paris, France.

Daily Evening Traveler, issue of May 23, 1878, published at Boston, Mass.

Boston Courier, issue of June 2, 1878, published at Boston, Mass.

Boston Herald, issue of June 1, 1878, published at Boston, Mass.

Baltimore Daily News, issue of April 29, 1878, published at Baltimore, Md.

Baltimore American, issue of May 21, 1878, published at Baltimore, Md.

Boston Sunday Herald, issue of April 14, 1878, published at Boston, Mass.

The Clipper, issue of February 28, 1880, published at New York.

Cincinnati Commercial, issue of March 11, April 1, and May 5, 1878, published at Cincinnati, Ohio.

Evening Journal, issue of May 9, 1878, published at Chicago, Ill.

Cape Ann Advertiser, issue of May 24, 1878, published at Cape Ann, Mass.

Dayton Democrat, issues of April 23 and May 11, 1878, published at Dayton, Ohio.

Daily News, issue of April 10, 1878, published at London.

London Daily Telegraph, issues of April 20 and May 22, 1878, published at London.

London Times, issues of January 17 and April 20, 1878, published at London.

London Morning Post, issue of April 20, 1878, published at London.

Evening Transcript, issue of May 23, 1878, published at Boston, Mass.

Boston Daily Globe, issue of May 24, 1878, published at Boston, Mass.

Boston Journal, issues of May 23, 25, and 30, 1878, published at Boston, Mass.

Boston Post, issue of May 24, 1878, published at Boston, Mass.

Boston Daily Advertiser, issue of May 24, 1878, published at Boston, Mass.

Frank Leslie's, issue of April 20, 1878, published at New York.

London Weekly Graphic, issue of March 16, 1878, published at London.

Lancaster Intelligencer, issue of February 25, 1878, published at Lancaster, Pa.

New York Mail, issue of April 26, 1878, published at New York.

Evening Post, issue of May 24, 1878, published at New York.

The Daily Fredonian, issues of May 27 and June 6, 1878, published at New Brunswick, N. J.

Evening Express, issue of March 20, 1878, published at New York.

The New York *Sun*, issues of April 28 and August 29, 1878, published at New York.

The World, issues of March 26, April 9, May 17 and May 31, 1878, published at New York.

The Weekly Sun, issue of February 27, 1878, published at New York.

New York *Herald*, issues of February 24, April 24 and April 28, 1878.

The Weekly Witness, issue of May 2, 1878, published at New York.

Newark Register, issues of May 3 and May 17, 1878, published at Newark, N. J.

The Daily Advertiser, issue of May 3, 1878, published at Newark, N. J.

Newark Evening Journal, issue of May 3, 1878, published at Newark, N. J.

New York Graphic, issues of March 15, April 2, April 18, June 8 and August 30, 1878, published at New York.

The Operator, issues of May 1 and June 1, 1878, published at New York.

The Public, issue of May 2, 1878, published at New York.

The Sunday Times, issue of April 7, 1878, published at Philadelphia, Pa.

Pottsville Miners' Weekly Journal, issue of April 12, 1878, published at Pottsville, Pa.

Philadelphia Inquirer, issue of April 20, 1878, published at Philadelphia, Pa.

Philadelphia Times, issue of March 9, 1878, published at Philadelphia, Pa.

Philadelphia Weekly Times, issue of April 27, 1878, published at Philadelphia, Pa.

Illustrated Police News, issue of May 24, 1878, published at New York.

Philadelphia Press, issue of March 9, 1878, published at Philadelphia, Pa.

Philadelphia Record, issues of March 9 and March 21, 1878, published at Philadelphia.

Philadelphia *Ledger*, issue of March 21, 1878, published at Philadelphia, Pa.

Portsmouth *Daily Chronicle*, issue of March 12, 1878, published at Portsmouth, N. H.

The State, issue of April 30, 1878, published at Richmond, Va.

Rochester *Democrat*, issue of March 13, 1878, published at Rochester, N. Y.

San Francisco *Chronicle*, issue of March 15, 1878, published at San Francisco, Cal.

St. Joseph *Daily Herald*, issue of May 23d, 1878, published at St. Joseph, Mo.

Washington Star, issues of April 19 and May 7, 1878, published at Washington, D. C., by the Evening Star Publishing Company.

"Workshop Receipts" (Third Series), page 172, published at London, in the year 1884, by E. & F. W. Spon.

"Engineering," Vol. 27, page 326 *et seq.*, published at London, April 18, 1879, edited by W. H. Maw and J. Dredge.

"Engineering," Vol. 27, page 202 *et seq.*, published at London, March 7, 1879, edited by W. H. Maw and J. Dredge.

Comptes Rendus, Vol. 85, page 1082, *et seq.*, deposited by Ch. Cros, April 30, 1877, descriptive of phonographs and their operation.

Scientific American, Vol. 37, page 304 *et seq.*, published at New York, November 17, 1877, by Munn & Co.

Scientific American, Vol. 39, page 118 *et seq.*, published at New York, August 24, 1878, by Munn & Co.

"Haslock's Metal Turning Handbook," published at London in the year 1882.

Telegraphic Journal, Vol. 7, page 53 *et seq.*, published at London, February 1, 1879, by Houghton & Co.

Telegraphic Journal, Vol. 7, page 151 *et seq.*, published at London, May 1, 1879, by Houghton & Co.

La Nature, issue of May 4, 1879, page 349 *et seq.*

Journal of the Society of Telegraph Engineers and Electricians, Vol. 8, page 303 *et seq.*, published at London, April 9, 1879.

"The Telephone, the Microphone, and the Phonograph," by Count Du Moncel, Chapter on Phonographs, pages 235 to 261, etc., published at New York, 1879, by Harper & Brothers.

Scribner's Monthly, Vol. 15, pages 857 *et seq.*, and 899 *et seq.*, published at New York, April, 1878, by Scribner & Co.

"Popular Science Review," Vol. 2, new series, page 219 *et seq.*, published at London, 1878.

"The Speaking Telephone, Talking Phonograph and Other Novelties," by George B. Prescott, Chapter 10, pages 292 to 308 *et seq.*, published at New York, 1878.

"Ganot's Elementary Treatise on Physics," pages 241, 242 and 243, published at New York, in the year 1883, by William Wood & Company.

"Elementary Treatise on Natural Philosophy," by A. Privat Deschanel, part 3, pages 824 and 815, published at London, in the year 1872, by Blackie & Son.

"Vorschule der Experimentalphysik," pages 263 to 266, *et seq.*, published at Leipzig, in the year 1883, by Duandt & Handel.

L'Architecte, issue of April 27, 1878, published in Paris, France, in 1878.

Le Monde Illustré, issue of April 6, 1878, published in Paris, France, in 1878.

"The Universal Engineer," issue of January 17, 1879, Vol. 2, page 33 *et seq.*, published in Manchester, England, edited by R. Z. Craven.

"The World's Weekly Review of Sciences," Vol. 47, pages 580 *et seq.*, published by Abbe Moigno, September-December, 1878.

Les Mondes, issue of December 12, 1878, published in Paris, France.

Scientific American, issue of June 7, 1879, published in

the City of New York, New York. (See inter Div. page 356).

"Lehrbuch Der Physik und Meteorologie," by Dr. John Muller, sixth edition in 2 vols., (see page 229, of Vol. 2), published at Braunschweig, Germany, in the year 1863.

Le Moniteur Scientifique Journal Des Sciences Pures et Appliquees, 3 Series, Vol. VIII, pp. 460, 462, published at Paris, in 1878.

And also in other printed publications at present unknown to this defendant, but which he craves leave to add hereafter as he may be advised.

22. That for the purpose of deceiving the public the respective descriptions and specifications, filed by said respective applicants in the Patent Office of the United States during the pendency of the respective applications for the patents in suit, were made to contain less than the whole truth relative to the respective alleged inventions and discoveries.

23. That in view of the state of the art at and before the date of the alleged respective inventions of the said respective patentees, and of which due proof will be made by this defendant, the said letters patent in suit do not describe anything which is lawfully the subject-matter for a patent under the laws of the United States, or which involves patentable novelty.

24. This defendant, further answering, says, that by reason of the amendments, disclaimers and arguments, filed during the pendency of the respective applications for the said letters patent in suit, the said patents, and each of them, are narrowly limited, if they should be held to be valid at all, to specific and detailed constructions of apparatus described and claimed, and that said letters patent, and each of them, were issued with their respective claims as allowed, narrowly limited to the specific constructions of apparatus and parts claimed.

25. That the said Letters Patent in suit respectively, and claims thereof, claim more than was, or is, the invention of the respective patentees.

That the said Bell and Tainter are not and never were the joint inventors of the alleged invention described and claimed in Letters Patent, No. 341,214, and that said Sumner Tainter and Charles Sumner Tainter are not and never were the inventors respectively of the alleged inventions described and claimed in the said Letters Patent, No. 341,288 and No. 375,579, respectively.

26. And this defendant is advised and believes, and thereupon submits to this Honorable Court, that by reason of the foregoing facts, severally specified, the said Letters Patent in suit, No. 341,214, No. 341,288 and No. 375,579, were and are null and void: and this defendant denies that he has ever infringed, or intended to infringe, or does now infringe, or threatens or intends to infringe, upon any of the rights of the complainant, and denies that he has realized or acquired any profits or gains whatsoever by reason of any infringements of any rights of the complainant, and denies that the complainant will be subject, as alleged, to great, irreparable damage or loss, or to any damage or loss whatsoever, if it does not obtain the relief sought and prayed for in its said Bill of Complaint.

27. In answer to the interrogatories propounded on page 11 of the said Bill of Complaint, this defendant would say:

"One.—This defendant has not made or sold any gramophones containing any of Complainant's said patented devices,

"Two.—This defendant has not made or sold any gramophone records containing any of complainant's said patented features."

All of which things this defendant is ready and willing to aver, maintain and prove as this Honorable Court shall direct.

This defendant prays the benefit of all the matters and things hereinbefore set forth and alleged, as if the same were specially pleaded where a plea would have been proper, or, as, if on account thereof, he had demurred to the said Bill of Complaint, or to part or parts thereof, where a demurrer would have been proper; without this, that any other matter or thing in the complainant's Bill contained, material or effectual to be answered, traversed, confessed and avoided, or denied, is true, all of which things this defendant will maintain and prove as this Honorable Court shall direct.

And humbly prays to be hence dismissed with its reasonable costs and charges in this behalf most wrongfully sustained.

HORACE PETTIT,

*Solicitor and of Counsel for Eldridge R. Johnson,
Defendant.*

March 6th, 1899.

IN THE
Circuit Court of the United States,

FOR THE
EASTERN DISTRICT OF PENNSYLVANIA.

October Sessions, 1898. No. 34.

IN EQUITY.

AMERICAN GRAMOPHONE COMPANY,
Complainant,

v.

BERLINER GRAMOPHONE COMPANY, THOMAS
S. PARVIN AND E. R. JOHNSON,
Defendants.

PHILADELPHIA, February 4, 1901.

Proof for final hearing taken on behalf of defendants under the provisions of Rule 67 in Equity, pursuant to agreement, before Samuel Bell, Esq., acting as Special Examiner by consent, at the office of Horace Pettit, Esq., 604 Stephen Girard Building, Philadelphia, beginning this date at 11 A. M.

Present: C. A. L. MASSIE, Esq., of Counsel for Comp't.
HORACE PETTIT, Esq., of Counsel for Defendant.

Counsel for defendant offers in evidence the following Exhibits:

United States Patents:

1. 27,827, April 10, 1860, Pease, Engraving Machine.
2. 38,823, June 9, 1863, Hayden, Rose Engine.

3. 200,521, February 19, 1878, Edison, Phonograph or Speaking Machine.

4. 213,554, March 25, 1879, Edison, Automatic Telegraph.

5. 219,939, Sept. 23, 1879, Hall Phonograph.

6. 227,679, May 18, 1880, Edison, Phonograph.

7. 283,665, Aug. 21, 1883, Rogers, Automatic Telegraph.

8. 387,166, Oct. 23, 1883, Reynolds, Phonograph.

9. 534,543, Feb. 19, 1895, Berliner, Gramophone.

10. 548,623, Oct. 29, 1895, Berliner Sound Record and Method of Making the Same.

English Patents:

11. No. 1,644, A. D. 1878, April 24, Edison, Recording Reproducing Sounds.

12. No. 6,027, A. D. 1886, (Star) to Johnson as amended Oct. 7, 1890, and the proceedings for the amendment thereof.

French Patents:

13. No. 124,213, May 15, 1888, delivered July 27, 1878, to Cros for New Methods in Phonography, translated.

14. Certificate of Addition to Cros Patent No. 124,213, taken August 3, 1878, translated.

Publications:

15. Comptes Rendus de L'Academie des Sciences of Dec. 1877, pp. 1,082 and 1,083, translated.

16. Lehrbuch de Physik und Meteorologie by Muller Pouileet Braunschweig Edition of A. D., 1868, Vol. 2, p. 252, Figures 253 and 254, translated.

17. Poggendorff's Annalen der Physik und Chemie published at Leipsic A. D., 1843, Volume 59, Plate 1, Figs. 1, 2 and 3, p. by Jacobi, translated.

18. The Telegraphic Journal, Vol. 7, p. 53, published at London, February 1, 1879, on the Carbonel Phonograph.

19. Engineering, Vol. 27, p. 326, published April 18, 1879, on Lambrigot's Phonograph.

20. Nature, published July 4, 1878, Vol. 18, p. 249, Article on the Phonograph.

21. The Telegraph, Microphone and Phonograph, by DuMoncel, Published by Harper Brothers, A. D., 1879, pp. 247-248.

22. The Telegraph, Microphone and Phonograph, by DuMoncel, published by Harper Brothers, A. D., 1879, p. 238.

Drawings and Photographs:

23. Chapman Photographs—Graphophone Grooves.

24. Chapman Photographs—Gramophone Grooves.

25. Graphophone Cutting Style and Scale Photographs.

26. Drawing of Graphophone and Gramophone Grooves.

27. Graphophone Reproducer Style and Scale Photograph.

28. Berliner United States Patent, No. 564,586.

29. Drawing of Gramophone Groove and Style.

30. Drawing of Gramophone Grooves and Style Track.

31. Drawing of Experimental Gramophone Reproducer.

32. Edison English Patent, No. 2,909, of 1877.

33. Extract and Drawings from "Engineering," Vol 27, pp. 199 to 202, London, England, March 7, 1879.

34. Dana and Silliman's American Journal of Science and Art, Vol. VIII, pp. 130 to 131, New Haven, Conn., 1874, and Lockwood Affidavit and Drawing attached.

It is stipulated and agreed by and between counsel for the respective parties that the proofs taken on behalf of the above entitled defendants herein shall be taken and considered as though separately taken on behalf of each of the respective defendants, and with the same force and effect as though the said proofs were separately taken in three separate depositions on behalf of said three defendants separately.

It is further stipulated that subject to correction upon discovery of error, that the copies of United States patents

introduced in evidence are true copies; that the copies of British patents introduced by the defendants and of the proceedings relative to the amendment of the Johnson patent, "Defendants' Exhibit No. 12," are true copies; that the translation of French patents, "Defendants' Exhibits," are correct translations, and that they may be used with the same force and effect as if accompanied by the original French patent; that the cuts and translations contained in "Exhibits 15, 16 and 17" are correct cuts and translations of the portions of the publications therein specified, and that "Defendants' Exhibits Nos. 33 and 34" are correct copies of the drawings and descriptions of the publications and articles referred to, and that the affidavit and tracing attached to "Defendants' Exhibit No. 34" is a correct copy of the affidavit and picture referred to, the original of which affidavit and picture is on file in an Interference Proceeding in the case of *Berliner v. White* in the U. S. Patent Office, Washington, D. C., and that these may be used with the same force and effect as if accompanied by printed copies of the original, or by the originals themselves; and that "Exhibits 18, 19, 20, 21 and 22" are correct copies of the portions and publications they purport to copy.

Counsel for complainant states that of course the foregoing stipulation as to correctness of translations, etc., intends that errors in translation, if discovered, may be established. He objects, however, to "Exhibits Nos. 1, 2, 9, 12, 16, 17 and 34" as not warranted by the answer filed on behalf of each of the defendants herein; this objection to extend to other exhibits if it appears that they too are not so warranted.

He further objects to "Exhibit 12," and the affidavit and tracing annexed to "Exhibit 34," as incompetent, irrelevant and immaterial.

RUDOLPH M. HUNTER, a witness called on behalf of the defendants, being duly sworn according to law, deposes as follows:

Q. 1. Please state your name, age, residence and occupation.

A. Rudolph M. Hunter; age, 44 years; residence, Philadelphia; occupation, mechanical engineer and solicitor of patents.

Q. 2. State your qualifications for testifying as an expert on behalf of the defendants in this case.

A. I am professionally educated in the arts and sciences, with particular reference to the qualifications of a mechanical engineer. I have designed, constructed and superintended the construction of large quantities of machinery of various kinds in the arts, comprehending structures from small, delicate mechanisms to machinery of very large powers. I have been engaged in business relating to patents since 1871, and have prepared and prosecuted a very large number of applications for letters patent. I have been frequently called upon each year for more than twenty years past to give expert testimony in suits involving the infringement of letters patent, and devoted a large portion of my time to this branch of my profession. During the last twenty-five years I have been frequently called upon as an expert, to make examinations and comparisons between patented structures and mechanical devices or mechanisms, with a view to determining and reporting to my clients upon questions of similarities and dissimilarities which might involve future questions of infringement. With regard to the art of reproducing articulate sounds I might say that I have endeavored to keep in touch with the same from its incipency up to the present time. I gave considerable attention to the matter of the reproduction of speech from vibrating diaphragms when the telephone first came into use, and had occasion to make quite a number of inventions in that line, some of which were controlled by the American Bell Telephone Company. When the phonograph first came before the public I took every occasion to familiarize myself with the same, and especially in regard to the work of Edison, and frequently had opportunity of observing the operation of the early phonographs then in use, and also in the later

developments thereof. I was also familiar with the art as disclosed in the various publications from time to time as I found much to interest me therein. As far back as 1887 I had occasion myself to develop certain improvements in phonographs and have been more or less in touch with the art ever since. With regard to inventions generally, I might say that I have made a great many inventions of my own, a number of which I have obtained letters patent upon, and these letters patent of my own inventions are about three hundred in number. I might also say that I have always carried on experiments relating to the development of the new lines of invention coming before the public from time to time, whether wholly of my own creation or as developments of the work of others, such experiments being what may be termed laboratory experiments and this work is continued by me to the present time.

Q. 3. Are you familiar with, and do you understand the various exhibits which have been introduced in this case?

A. I am familiar with the various exhibits and believe that I fully understand the same, and their relation to the matters here involved.

Q. 4. State whether you understand the three patents in suit and the construction and operation of the devices and things claimed therein, especially those devices and things claimed in the claims, particularly referred to and considered in Mr. Cameron's deposition.

A. I understand the construction and operation of the devices set out in the three patents in suit, to which my attention has been directed, and especially to those portions thereof which have been treated of by Mr. Cameron.

Q. 5. State whether you are familiar with the deposition of Mr. Cameron produced in complainant's *prima facie* proofs in this case.

A. I am.

Q. 6. Will you kindly give an exposition of the history of the art of recording and reproducing sounds up to the date of the filing of the application for the U. S. Patent of

Bell and Tainter, which subsequently issued bearing the number 341,214, in suit, referring in this connection to the said deposition of Mr. Cameron in so far as it covers the same ground.

A. Prior to the work of Mr. Thomas A. Edison, which was the first tangible and practical evidence given to the public of a practical talking machine, or one which mechanically operated a diaphragm from a prepared record to produce articulate speech, there was practically no art available, so that we might say that the origination of this invention, so far as the public had a knowledge of it, originated with Mr. Edison. However, prior to his work a Frenchman by the name of Cros, claimed to have ideas upon this art which he elaborated more or less in a written document and which he deposited with the Academy of Sciences of France, the deposit taking place on April 30, 1877, and the writing being a sealed document, which was not opened until a later date when the same was opened and read, at his request, to establish the fact that prior to Edison, he had conceived the art of recording and reproducing speech. For this reason I will consider Mr. Cros's work, or rather his publications, or those due to him which are intended to specify the character and nature of his ideas, prior to taking up the development of the art by Edison.

While reproducing speech or musical sounds from a previously prepared record, had not been accomplished prior to the work of Edison, or prior to the suggestion of Mr. Cros, in 1877, nevertheless the suggestions for recording graphically the vibrations due to articulate speech or sounds, referred to and employed by these gentlemen, was known long prior to their work. There are but two general illustrations of machines for recording the vibrations of sound, and these are the earliest and original apparatus of Duhamel, a French scientist, who reproduced upon a travelling blackened surface the vibrations from a tuning fork. The apparatus he used consisted essentially of a drum or cylinder about which was wrapped a sheet of paper having therein a coating of

lampblack, the said drum being supported in bearings so that it might be revolved by a crank, and, at the same time, was operated upon by a screw which produced a rectilinear motion, causing the drum to be fed longitudinally of its axis, simultaneously with its revolution. The tuning fork was supported close to the drum and was provided on one of its prongs with a style, the point of which lightly pressed upon the blackened paper and traced thereon a line which, when the fork was not in vibration was a straight spiral, but which, upon vibrating the fork, became a sinuous line, or one which might be termed a lateral undulatory tracing. This record was only employed to show the number of vibrations which a fork of a given pitch would produce per minute, but, incidentally, it reported the amplitude of the vibrations under different degrees of loudness of the sound. This is the first evidence of a record of this character.

The next apparatus which came to the knowledge of scientists in connection with recording sound, was that of Leon Scott, who so modified the Duhamel apparatus as to substitute for the tuning fork a sound receiving funnel or box of plaster of Paris, fitted at the closed ends with a diaphragm, which operated the style. This apparatus enabled the recording of the vibrations of articulate speech, as well as those of musical sound. It, moreover, reproduced complex vibrations produced by a multiplicity of sound, which was a great advance over the Duhamel device. The character of the record produced upon the Leon Scott apparatus, or phonautograph, is the same in general character as that of Duhamel's structure, but produces records which may have greatly more complex sinuosity. Various types of the Leon Scott phonautograph are known in the various laboratories and technical schools according as they have been produced by such men as the instrument maker, Koenig, of Paris, and Prof. Helmholtz. An excellent example of an instrument of this character is in use in the Institute of Technology of Boston, in charge of Prof. Cross. It is described in Dana and Silliman's American Journal of Science and

Art, 3rd Series, Vol. VIII, published at New Haven, 1874, and found on pp. 130-131 under Article XIV entitled "The Phonautograph" by Charles A. Morey. A copy of this article being entered in this case as Exhibit 34. Annexed to the descriptive matter is a perspective drawing of the diaphragm and stylus of the Phonautograph instrument described by the article of May 24, 1874, and annexed to the drawing is the copy of an affidavit of Thomas D. Lockwood, accurately describing the construction of this diaphragm and stylus. In describing the apparatus, in the affidavit, Mr. Lockwood states :

"The photograph represents the vibrating diaphragm, and its simplifying stylus lever detached from its supporting crank, the ring which holds the vibrating diaphragm is about four and three-quarters ($4\frac{3}{4}$) inches in diameter, and that portion of the said diaphragm which vibrates is two and one-half ($2\frac{1}{2}$) inches in diameter, the total length of the stylus lever is twelve (12) inches. When in use, there is attached to the extreme, free, end of the lever a stylus consisting of a stiff bristle or a straw.

I also find that the article of May 24, 1874, contains the following :

"Instead of attaching the style directly to the membrane, it is attached to the end of a long lever. This may be of any length (the one used being about 12 inches), and is made very slender and light, either of deal or a stiff straw. This is attached at the end with a brass ring which holds the membrane by a single hinge of goldbeater's skin, and also the membrane itself by a short, flexible bristle, or a piece of broom-corn. This is inserted into the lever and is fixed with a drop of glue ; the other end is fixed to the membrane as the style usually is, either by a drop of glue, or sealing wax, the former being preferable. The whole attachment can readily be made so light as to encumber the membrane but very little."

The drawing annexed to this description as graphically illustrating the diaphragm and style is made from a

photograph taken from the machine, and will give an excellent idea of the construction. It does not show clearly the positive, rigid connection between the long lever or style and the centre of the diaphragm, which the description states is made by a short section of broom corn cemented at one end to the diaphragm, and at the other end to the style lever, but it does ~~show~~ show very clearly a long style pivoted at one end to the frame of the diaphragm positively connected with the centre of the diaphragm and having its free end extended beyond the diaphragm so as to be readily seen when in operation upon the recording surface. Furthermore, it is shown as made very long, so that the extent of its vibrations at the free end are greater than at the point of connection of the style lever with the diaphragm. According to the affidavit, this instrument was used by Professor Bell in experiments made during the year 1874, and is also referred to by Professor Bell in his personal communication to the Society of Telegraph Engineers, London, England, on Oct. 31, 1877, and which was printed in the Journal of the Society of Telegraph Engineers, Vol. 4, 1877, No. 20, p. 404.

While the phonautograph was excellently adapted to recording sound vibrations, and while the diaphragm and style was also well adapted to reproducing articulate speech, if used in connection with a suitably prepared sound record, still, as I have before mentioned, the first disclosure of such an attempt given to the public at large was by Edison, and the first practical results with the machine were also accomplished by him. Before taking up Edison's work, I will briefly refer to Mr. Cros's suggestions showing that while he contemplated more or less similar ideas and modes of operation to those of Edison, still his suggestions were not so practical and not liable to have produced the results secured by Mr. Edison without the development of improvements which were secured only after a lapse of many years, and then, too, not by Mr. Cros himself. The sealed paper submitted by Mr. Cros to the French Academy was published in their proceedings (*Comptes Rendus*) and a translation of that is in

evidence in this case as "Defendants' Exhibit 15." Briefly stated, the contents of the paper may be taken as a suggestion that if a phonautograph record is photengraved it may be used for the reproduction of sound by means of certain reproducing apparatus.

Specifically, the Cros paper says that the phonautograph record may be made upon a disc or cylinder in substantially the same fashion in which it would be produced by the phonautograph of Leon Scott. He then says that the lines so traced may be obtained with all their sinuosity, either in intaglio or in relief, upon the surface of some suitable resisting material, such as tempered steel. He then suggests that if the resisting record thus obtained be moved in the same manner as the record surface in the original instance, and while thus moving a metallic point, or a notched finger, is held against the sinuous record lines, and such point or lever being in connection with the diaphragm, the recorded sounds will be reproduced. Broadly stated it was Cros's idea to make a phonautographic record, fixed in resisting material, and then to use that record for the reproduction of the recorded sounds. It is thus seen that the broad idea of reproduction of articulate speech was before him in April, 1877, before Mr. Edison gave to the world his phonograph, but such knowledge was kept to himself except so far as it may be found in the sealed paper deposited by him with the French Academy, or as it may have been disclosed by him to private individuals. Speaking of the style to be used in connection with the record, Mr. Cros uses the following language :

"A metal point, if the tracing is in grooves (or a notched finger, if it is in relief,) is held by a spring on this tracing, and at the other end the finger which supports this point is solid with the center of a face of the suitable membrane for producing the sound."

This passage might be said to contain the essence of his suggestions regarding the reproduction of sound so far as accomplishing it by an apparatus is concerned, since the pro-

duction of the record was by the old phonautographic method and the formation of the record in a permanent record was by the old photo engraving process. It, however, is evident that he had in his mind the idea of a style being operated by a moving record and said style causing a diaphragm to vibrate. It also is evident that the preferred character of record which he desired to employ was one in which the irregularities were transversely undulated, namely, one in which the depth of the record would be uniform and the lateral edges of said record be relied upon to secure the vibrations of the diaphragm.

Later, in May, 1878, and after Edison Phonograph was known to the world, Mr. Cros applied for French Patent, which was delivered on July 27, 1878, and numbered 124,213. A translation of this patent is in evidence as "Defendants' Exhibit, No. 13." On August 3d, 1878, Cros took out a certificate of addition to his patent above referred to, and a translation of this addition is also in evidence as "Defendants' Exhibit No. 14." This patent of Cros's makes numerous suggestions as to possible methods of recording and reproducing sound, but it is only certain portions of said patent and its additions that are of special moment in this case. One of these suggestions which deserves notice is set forth in the following words :

"The lampblack can be replaced by a body insulating an underlying metallic plate from the engraving action of an acid. In this case the work of the stylus is increased by the cohesion of the insulating substance. Tallow, paraffine, the varnish of *Aquæ fortis* can serve.

"In this case nothing but an excavation is obtained which is good for the repetition with a jet of air, or with a solid point entering into the excavation and causing a sonorous body to vibrate."

These two paragraphs contain a suggestion comprehending the coating of a metallic plate with an insulating substance, tracing a phonautographic record through the insulating substance so as to expose a sinuous line of the metal to constitute the record, then etching the said plate

with an acid to eat into the metal to establish and fix the sinuous line therein as an excavation by the well-known etching process. This will produce a record groove of uniform depth and laterally undulating in its irregularities. The suggestion is also made that such an etched record may produce a reproduction of speech or sound by employing a solid point or style which is required to enter and follow the said groove and be connected with a sonorous body such as a diaphragm to put it into vibration. The suggestion is there of a practical application for the reproduction of speech, but no accurate mechanism or apparatus is disclosed in the patent wherewith to carry out the suggestions and secure the embodiments of the principles suggested in a practical manner.

While Cros particularly describes the etching process in connection with Phonautographic record, he states in his patent:

"I see three kinds of tracings, the transversely undulating tracing, a tracing undulated in depth; a simple linear tracing," * * * etc., etc.

The first of those tracings or records is the one that I have above referred to; the second is the character of record used by Edison, and later by the complainant. At this point I would say that the first of the records, namely, the transversely undulating record groove, is that used by the defendant. This is interesting and important in that it is at this point where the work of the several parties in the later development of the phonograph deviated. That of Edison and Bell and Tainter, the complainants in this case, following the system or method involving the use of the "tracing undulated in depth," or what is termed in this case the vertically undulating record, whereas the defendants followed the path leading from the "transversely undulating tracing," which has been termed in this case the transversely undulating record.

It will be observed that Cros suggested a process in producing his record which was in effect an engraving method, in that the insulating material was cut through by

the style, but as it was not considered of sufficient solidity or firmness to be used directly for reproduction of sound, he did not propose to use such an engraved record as the immediate means for operating a reproducer. He, however, described in his patent a means for directly engraving a metal wire by the action of a stylus, and reproducing directly from said engrafted wire, or, if desired, reproducing from the record so made, by mechanical means of duplication thereof, and using the said duplicate for actuating the reproducer.

Count De Moncel, in his book entitled "The Telephone, Microphone and Phonograph," an extract from which is here in evidence, as "Defendants' Exhibit, No. 22," refers to Mr. Cros's invention, and, among other things, says, when comparing the date of Edison's invention of the phonograph with that of Cros:

"Mr. Edison's phonograph was only patented in January, 1877. Consequently, when we look at the principle of the invention, Mr. Cros undoubtedly may claim priority; but it is a question whether the system described in his sealed paper, and published in the *Semaine du Clerge*, Oct., 1877, would have been capable of reproducing speech."

The reference to Edison's patent as January, 1877, was an error, as it should have been July, 1877, which was after the date of Cros's paper of April, 1877. Count Du Moncel questioned the operativeness of Cros's suggestion because he had an idea that the reproduction of sound should be directly produced by the actual record produced by the phonograph itself in the first instance. This is conveyed by his statement in the above book:

"When we have to do with such undulations and complex vibrations as those involved in the reproduction of articulate words, it is necessary that the stereotyping should in some sense be effected by the words themselves, or their artificial reproduction will necessarily fail to make the slight differences which distinguish the delicate combinations of speech. Besides, the movements performed by a point confined to a groove that follows

a sinusoidal curve cannot be effected with all the freedom necessary for the development of sounds and the friction exerted on the two edges of the groove will often be of a nature to stifle them."

It thus appears that Du Moncel while recognizing the success of the Edison Phonograph, which used the vertical undulatory record such as proposed by Mr. Cros, would be a commercial success. That he was in error in this is fully evidenced by the wonderful success of the gramophone, but of course it should be recognized that the success of this instrument is largely due to the great development and improvement over the original suggestions of Mr. Cros. One thing which should be kept in mind in connection with Du Moncel's publication, is that this learned scientist clearly recognized that the two types of records, namely, the vertically undulating record of Edison, and the laterally undulating record of Cros, were very materially different in operation and possibility in connection with apparatus to complete a reproducing instrument. It has always so been recognized and the development of the two classes of instruments has led to many experiments radically differing and involving different methods of operation, the one being represented by the class of machines produced by the complainants, and the other the class of machines produced by the defendants.

While Cros has thus placed himself on record as being the first to suggest the use of a laterally undulating sound record for operating a reproducer, the suggestion was entirely lost sight of through many years of the early development of the phonograph, except so far as it was in a general way suggested by Mr. Edison himself in some of his patents, and it only made its appearance again after a period of about ten years, and then only when it was rehabilitated by improved processes and greatly perfected apparatus as the immediate developments of Mr. Emile Berliner in the production of the commercial gramophone involved in the suit and made by the defendants.

Adjourned until Tuesday, February 5, 1901, at 11 A.M.

PHILADELPHIA, February 5, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of witness continued.

(Witness continues his answer to Q. 6.)

Perhaps the first clear notice to the public in a publication of Edison's work is the Scientific American article on November 17, 1877, which was a communication from a co-worker of Edison's, a Mr. Edward H. Johnson. In this article Mr. Johnson points out very clearly Edison's ideas regarding the recording and reproducing of sounds, especially in connection with an engraved record in which the irregularities are such as to produce a vertically undulatory record. Briefly stated, this article describes Mr. Edison's apparatus, or at least one form of it, as embodying a recording diaphragm operating "a small, chisel shaped point" which indents or cuts the upper ridge of a previously crimped paper strip, in which there was a longitudinal raised V-shaped boss, such as would be made by passing a fillet or strip of paper through a Morse register with the lever constantly depressed. The action of the diaphragm produced in the ridge of this V-shaped boss a series of indentations or cuts producing the record, which is then fed along and under a reproducer comprising a second diaphragm, provided with a delicate style adapted to rub upon the record produced as above described. The paper is fed by a drum revolving by clock work. The reproducer or, as it is termed in the article, "reproducer," is similar to the recording or indenting apparatus except that the diaphragm is more delicate, as is also the style. The reproducer was essentially a development of Mr. Edison's and that in connection with the practical mechanical production of a suitable record separately and operating in conjunction may be taken as the essence of Mr. Edison's inventions, substantially the same idea of producing a record on a ridge whereby it is in relief as distinguished from being in a groove, is also referred to in Edison's caveat of March 8, 1878, and more particularly in Fig. 70 thereof. It is, moreover, also disclosed in his British

patent, No. 2909, of 1877, "Deft. Ex. No. 32," the application of said patent having been filed on July 30, 1877, but not disclosed to the public until about January, 1878. Fig. 6 of that patent illustrates this method of reproducing.

While Edison, therefore, clearly disclosed his ideas whereby he may employ a vertically undulatory record to operate a reproducer, for the purpose of reproducing articulate speech, in the manner set out in the article of the "Scientific American" referred to, he in no wise confined himself to that particular type of apparatus, as he developed this art in various directions, and the more important of these embodied the principle of a depressed vertically undulatory record, or one in which the operating portion of the record was at the bottom of a groove, the said groove being either a helical groove about its cylinder or a spiral groove upon a plate or disc. His original and practical machine exhibited to the public were of these characters, and the one most commonly seen was that employing the helical groove. This construction of apparatus will be readily understood by reference to his American patent, No. 200,521, of Feb. 19, 1878, Defendant's "Exhibit, No. 3," and to which I will briefly refer. A drum A is fixed upon a shaft X, which is screw threaded at one end and caused to be fed through a stationary nut P, in which it is located by a suitable clock work or motor M. The drum A is provided on its periphery with a helical groove, the pitch of this groove being the same pitch as the screw of the shaft. A record plate or tablet is wrapped about the drum and is revolved with it. To one side of the drum is arranged a mouth piece B, having a diaphragm G furnished with a style which presses upon and indents the tablet wrapped about the cylinder. The adjustment of this indenting style is such that it presses upon the tablet in a line with the centre of the helical groove, and so as to depress the same into the groove to such an extent as to produce sloping sides or walls. If the cylinder is now revolved, a helical groove will be formed in the tablet which will have uniform depth. If, now, sounds are so delivered to the diaphragm that it is caused to

vibrate by speaking into the mouth piece B, the bottom of the groove will be indented or caused to take an undulatory form, the curves of which will be below or above what would otherwise be the normal bottom of the groove, according to the pressure exerted by the diaphragm upon the style. In this manner we will have produced a record groove in the tablet having sloping side walls and with a vertically undulating bottom. At the opposite side of the drum is arranged a reproducer comprising a diaphragm F of more delicate membrane and a delicately arranged style D consisting of a style point attached to the free end of the light spring, the end of said spring being connected with the diaphragm by a thread or other suitable means. The reproducer is so adjusted relative to the cylinder that its style rests upon the bottom of the groove, and is thereby acted upon by the undulating surface of said groove. Regarding the reproducer the patent states :

"C is a tube similar to B, except that the diaphragm is somewhat lighter and more sensitive, although this is not actually necessary. In front of this diaphragm is a light spring D, having a small point shorter and finer than the indenting point on the diaphragm of B. This spring and point are so arranged as to fall exactly into the path of all the indentations. This spring is connected to the diaphragm F of C, by a thread or other substance capable of conveying the movement of D.

It will be observed that in the description of his apparatus, Mr. Edison points out that the reproducing style should be finer than the indenting point, which is proper and has been demonstrated by subsequent development of the phonograph as being practically essential where a vertical undulating sound-record is employed.

The material of which the tablet was composed in the early instruments of Mr. Edison, were usually tin foil, and this was wrapped about the cylinder tightly so that it rested upon the crown or helical ridge dividing the adjacent grooves. This left the central portion of the coil over a groove unsupported, so that it was in excellent condition to receive the indenting action of the recording style. But while Mr. Edi-

son largely used tin foil, he recognized that they were many other substances excellently adapted to the purpose, and especially a composition of wax. the use of wax being more preferably in the form of paraffine or stearine, the latter very largely comprising the composition of the modern metallic soap records now commonly in use. The stearine wax is more particularly referred to in Edison's English patent, No. 1,644, of 1878, and "Defendants' Exhibit, No. 11," and to which I will shortly refer. At that time, when proposing to use a waxy substance, Mr. Edison proposed to apply it to a sheet of paper, a strip of paper, or a card, employing these substances as a base for supporting and conveying the more sensitive composition upon which the record was to be formed. In some cases he proposed to use the waxy surface as the immediate material upon which the indenting or cutting style of the recorder operated, while, in other cases, he proposed that such waxy compound should be coated with a thin sheet of tin foil whereby the indenting point of the recorder would be kept clear of contact with the wax " and thus obviate any possibility of becoming clogged. That Mr. Edison had no idea of limiting himself to any particular material is evident from the language of the specification of this patent, No. 200,521, in which he says :

"The invention consists in arranging a plate diaphragm, or other flexible body capable of being vibrated by the human voice, or other sounds, in conjunction with a material capable of registering the movements of such vibrating body by embossing or indenting or altering such material, in such a manner that such register-mark will be sufficient to cause a second vibrating plate or body to be set in motion by them and thus reproduce the motions of the first vibrating body."

It is evident that this language would include not only the tin foil, but a tablet or surface of wax or waxy material, which may be indented or altered in the line of a groove. While he describes in his specification the use of tin foil as preferable he nevertheless clearly implies that this is not

essential because, on page 2, in referring to a stereotyping method of multiplying the records, he says:

"The record, if it be upon tin foil, * * *"

Further on, he states that the material upon which the record is to be made may be

"soft paper saturated or coated with paraffine or similar material, with a sheet of metal foil on the surface thereof to receive the impression from the indenting point."

Two other substances for records are also disclosed in this patent, namely, one in which the groove is formed in paper, and the other in which the record is formed by depositing upon a strip of paper an ink which produces raised portions and which constitutes in effect a vertically undulating sound record. I had frequent occasion to observe the operation of these early Edison phonographs and to examine the records produced thereby, and while they did not embody all the nicer constructions and perfect reproduction of articulate speech and sound, of which the more modern machines are capable, they were, nevertheless practicable embodiments of the art of reproducing by the employment of a vertically undulatory sound-record with sloping side walls, in connection with a diaphragm and delicately mounted style, tracking in the bottom of the record groove. The construction of the original machines employing the drum and screw feed, were of such simple character that very little adjustment was necessary, and there was, therefore, very small liability of the reproducer not following the record surface of the bottom of the groove, but as the development of the art progressed, complications were introduced into the mechanism for making the devices more automatic, regarding the feeding element of the machine, and also in forming the record grooves on a very much finer scale, thus increasing the liability of the reproducing style working out of strict alignment with the bottom of the groove. Even to overcome this possible defect or trouble, a delicately mounted style, such as disclosed in the early Edison patents, would, in a large measure, if not wholly,

overcome such difficulties. For example, it would only be necessary to so flexibly support the style that it might be retained in the bottom of the record groove by the gravity action of the style itself, as would undoubtedly take place in the freely supported style indicated in Fig. 8 of Edison's English patent, No. 2909, of 1877, "Defendants' Exhibit, No. 32," and in Fig. 27 of his English patent, No. 1644, of 1878, "Defendants' Exhibit, No. 11." That this is evident will readily be understood when we bear in mind that the Edison machines all involve a mechanical feed where a disc or cylindrical tablet were employed, and, consequently, the only possible displacement of the style relatively to the bottom of the groove would only be a portion of the width of the groove itself. While no difficulty was experienced in this regard with those types of the Edison machines where the grooves were fairly wide, this difficulty would naturally grow as the grooves became narrow, but just in the same proportion would the gravity type of style shown in these two patents more effectively meet any requirement in this regard. The finer the groove the less possible displacement of the style in the groove, and consequently, the less lateral adjustment would be required of the style mounting, as under no conditions would said lateral capacity of adjustment be required for more than approximately one-half the width of the groove, which, in the modern machines, would be about a one two-hundredth part of an inch.

I notice that Mr. Cameron, in his testimony, characterizes the early Edison phonographs to be very imperfect, and largely asserts that these defects inherent to it were mainly due to the fact that the reproducer had to be adjusted, "by the exercise of great care and skill." I do not agree with him, as I never saw any great difficulty required to be overcome in using the early Edison phonographs. While Mr. Cameron speaks of the Edison record groove of the early machine, as "exceedingly fine" and as "a thread like line" this language must be taken in a comparative sense, for while it might be so designated as compared with coarser structures found in

the arts, nevertheless the original Edison grooves were exceedingly coarse affairs as compared with the present fine record grooves of the modern machines. On account of everything being on a larger scale in the original Edison phonographs it was, as I have before pointed out, perhaps more easy to insure the reproducing style following the bottom of the groove than is the case with the more modern machines employing the same types of mechanical feeds, but with the grooves very much finer. This is evident from the fact that while the elements involved in the feeding mechanisms do not decrease the possibility of lost motion, but rather increase it, the fineness of the record groove necessitates somewhat more accurate adjustment of the reproducing style to insure it tracking the groove and remaining at the bottom thereof. Moreover, this difficulty is very largely due to the fact that in the modern machines, the mode of substituting new record is such that there is no absolute certainty of the position which will be assumed by the record groove beneath the reproducing style. That this is evident, will be readily understood when we bear in mind that the width of a modern record groove is only about $\frac{1}{100}$ part of an inch, and, therefore, if the record were crowded on the drum a little more firmly in one case than in another, the relative adjustment of the record groove to the reproducing style would be different. Furthermore, if the record is placed upon the drum without regard to its position, circumferentially considered, it is clear that we may so arrange it that the operative point of the groove may be thrown either to the left or right of the style, to any extent within the width of the groove, thereby again slightly displacing the record from the true position which it should have upon the drum, and relatively to the style. This possible displacement of the record under the reproducing style in the modern machine, is also very largely due to the fact that the records are supposed to be interchangeable with a standard class of machines, but it is self-evident that it is practically impossible in substance of the nature of a waxy compound to so form

the records that they will, under all conditions, fit upon the drums, to exactly the same spot or position. Such would be an utter impossibility under any ordinary process of manufacture which could be commercially carried on as a business. The trouble, therefore, is an incident which has gradually crept into the more modern machines and while adequate provision existed in the prior art, to compensate for this trouble, there appeared at the time no necessity for elaborating upon or building around it theories of great advantage and of wonderful ingenuity in overcoming it. In the early days of the phonograph, there were many other important considerations to be kept in mind *involving the development of the phonograph into a form to make it practical*, whereby it could be manufactured extensively and placed in the hands of the inexperienced public with a reasonable assurance of successful operation. In all of Edison's earlier productions, reasonable capacity for adjustment was provided, and whether this automatic or self-adjustment capacity was relatively increased as the development of the art progressed, it seems to me that such modification of the apparatus which might have been made in this regard, was very largely a matter of mechanical skill.

Recess.

(Witness continues his answer.)

In the Edison patent, No. 200,521 "Deft. Ex. No. 3," to which I have last referred, there is a statement on page 2, relative to the modification of apparatus which may be constructed embodying the general principles, however, of the system of reproducing illustrated in Figs. 1 and 2. This statement is as follows:

"It is obvious that many forms of mechanism may be used to give motion to the material to be indented. For instance, a revolving plate may have a volute spiral cut both on its upper and lower surfaces, on the top of which the coil or indenting material is laid and secured in a proper manner. A two-part arm is used with this

disc, the portion beneath the disc having a point in the lower groove, and a portion above the disc carrying a speaking and receiving diaphragmic devices which arm is caused by the volute spiral groove upon the lower surface, to swing gradually from near the centre to the outer circumference of the plate as it is revolved, or *vice versa*.

An apparatus of this general character adapted to a magnet that indents the paper is shown in my application for a patent, No. 128, filed March 26, 1877; hence no claim is made herein for such apparatus, and further description of the same is unnecessary."

The application thus referred to as having been filed on March 26, 1877, was subsequently issued as Patent No. 213,554, dated March 25, 1879, a copy of which patent is here in evidence as "Defendants' Exhibit, No. 4."

The invention described in this patent is an automatic telegraph and, for the purpose of the present case, it is only necessary to refer to such features of it as are referred to by Mr. Edison in his patent, No. 200,521. This part of the apparatus of a disc or turntable a, adapted to rotate upon a vertical shaft in a horizontal plane. It furthermore, employs two styles, each upon a universally mounted arm, and said styles adapted to be held in engagement with the turntable or disc, or the material support thereon. The turntable has a spiral groove formed in its upper face, and a corresponding spiral groove in its lower face, the two spirals having the same pitch, and are shown in the drawing as being concentric. The arm m, which carries the lower style, 1, which is in engagement with the lower groove 8, is a bell crank lever, pivoted in a block o, which in turn is vertically pivoted by a pin o.¹ The upper arm n, is mounted in precisely the same fashion as the lower arm; it is also a bell crank lever, and carries at its outer or free end a tracing style 12. The upper arm or lever n, is also pivoted to the block o, and the short arm of the two levers m and n engage, so that when the upper lever n, is moved away from the disc, the lower arm is also moved

away and *vice versa*. When the arm n, has its style resting upon the material on the upper surface of the disc, the pin or style r, of the lower lever, projects into the spiral groove upon the under side of the disc. The disc is revolved by clock work, and its revolution causes the two levers to travel radially across the surfaces of the disc, under the feeding action of the lower spiral. It will furthermore be observed that both of the levers, n and m, are pivoted in such a manner as to *have universal movement*, namely, a movement about a horizontal axis and also about a vertical axis. Referring more particularly to the construction of the upper arm, I find that it carries, in fact, two styles, one an indenting style 6, and one a tracing style 12. The indenting style is indented by an electro magnet r, by which it is depressed by response to electrical impulses, and is thus made to indent a sheet of paper that is placed upon the upper surface of the table, and in alignment with the spiral groove. These indentations bear a great resemblance to the indentations made by the Edison phonographic recorder, that is to say, they are comparatively shallow and narrow grooves with sloping walls. The tracing style 12, is mounted upon a leaf spring v, fixed with one end to the lever n, and in the use of this tracing style it engaged the indented grooves, and rides up on to the not indented or less indented portions of the paper, and then again rides down into the indented or more indented portions of the paper, as the case may be. These up and down movements of the style makes and breaks an electric circuit, by which similar records are made at a distant station. The machine, therefore, performs two functions, namely, recording telegraphic messages, and automatically reproducing these messages at a distant station.

In the operation of this apparatus, the upper lever arm, n is allowed to fall by gravity and is supported by the paper or material operated on by the use of a little spring, 13; the lever, therefore, floats, as it were, and is gravity actuated. The style, 12, carried by the spring, v, also connected with

the arm, n, is pressed downward upon the indented paper with a gentle pressure, and thereby permitted at all times to follow the irregularities of the said paper produced by the recording style. As the table rotates under the operation of the motor, the style, 1, on the arm, m, causes the upper arm, n, and its style to be propelled uniformly and radially across the record tablet, and in this manner the reproducing, style 12, is always guided in the line of the indented portions of the tablet. The operation of the electro magnet, r, acting upon the style, 6, causes said style with each impulse to be forced down upon the paper exactly above the groove in the table, and indents the paper as long as the style remains depressed. The pressure which the recording style exerts upon the paper in indenting it gradually, although rapidly increases from zero to a maximum, and when the recording style is again withdrawn from the paper, the pressure which it had exerted gradually, though rapidly, decreases again to zero. The grooves, therefore, which the style makes are shallower at the ends than in the middle, and in this manner, a record groove is obtained in a tablet having various depths, or being in a sense a vertically undulatory record.

In reproducing with this instrument, the same general operation is carried out, except that the electro magnet, r, is not energised, and consequently the recorded style is not reciprocated. The reproducing style, 12, in this case, rides over the irregularities of the record, and in this manner reproduces the recorded message at a distant station.

It will be seen that in this machine there is a record groove extending in the line of a spiral; that there is a style which tracks this groove, and which was held in engagement with the groove by gravity, slightly counteracted by the resiliency of a spring, and that this style is mounted upon an arm, which, in turn, is provided with a *universal joint*, so that it can move up and down and also laterally. In other words, the reproducer is mounted on a universal joint, and is held against the record by a yielding pressure.

In this patent Mr. Edison says :

"The underneath spiral might be dispensed with, and the spiral on top of the plate might be continued out a greater distance from the centre, and the additional spiral used for giving an outward movement to the arm."

This modification is that which is fully disclosed in some of the illustrations of his English Patent, No. 1644, of April 24, 1878, "Deft. Ex. No. 11."

Referring now to this Edison British Patent, No. 1644, of 1878, I quote from the specification :

"By extensive experiment and research, I have been enabled to obtain very perfect articulation and to produce a record in a convenient form for preservation.

"The sound vibrations are made to move a point that by preference is a diamond or other very hard substance, and of peculiar shape. The sound vibrations in the atmosphere act upon a diaphragm, or other body capable of motion, and the same moves the indenting point, and acts as a phonograph. The indented material is properly designated a phonogram. * * *

"The instrument, or portion of the instrument, that reproduces the sound from the phonogram, I term a 'phonet.' * * *

"The phonogram may be in the form of a disc, a sheet, an endless belt, a cylinder, a roller, or a belt, or strip, and the marks are to be either in straight lines, spiral, zig-zag, or in any other convenient form, so long as the apparatus is adapted to bring the same into contact with the phonet or speaking part of the apparatus, and the reproduction of the phonogram from a matrix or copy in relief of an original phonogram may be made upon a belt, roller, cylinder, plate, or other convenient surface. * * *

"It is important that the point used in the phonet correspond in shape to that of the phonograph, but slightly smaller, so as to follow the bottom of the depressions without contact upon the sides."

The above quotations show very clearly that Mr. Edison contemplated the use of discs and cylinders as records such as used at the present day; also that the cylinders were to

have a spiral groove, and in being produced originally, were to be formed by a record style having very hard characteristics, which is also substantially followed in the commercial practice of to-day; it also shows that the groove of the record was to be formed in such a manner that it had a bottom and sides or walls, as it expressly states that the reproducing point of the reproducer or phonet is "to follow the bottom of the depression without contact upon the sides," which is the essence of many of the contents regarding the character of the reproducing devices employed by the complainants, and as necessary to a commercial phonograph as made at the present time.

As this patent specifically describes the manner of forming the irregularities or undulations in the bottom of the groove, it is quite evident that we have in this patent a record groove having sloping side walls and a vertically undulating record at the bottom of said walls and joining them, which record is specifically described as being adapted for use in connection with a reproducing style of a shape smaller than that of the recording style which formed the record groove so as to specifically follow the bottom of the groove and avoid, as far as possible, contact with the sloping side walls.

It will also be seen from the quotations above placed upon the record, that Edison had clearly defined ideas regarding a commercial *interchangeable record*, namely, one which might be reproduced and sold as an article of manufacture *adapted to be used upon other phonograph machines* than that on which the original record was produced, and which is now the commercial practice, and I would particularly refer to his description of making this phonogram or record tablet in the form of a cylinder, having the spiral groove arranged thereon, which is the commercial type or form of record tablet commercially used not only in the Edison machines, but upon the graphophone machines also. Moreover, they are record tablets in which the record groove has sloping side walls, and a vertically undulating bottom, conforming precisely and identically to the record used by the complainants.

The drawings of the patent illustrate several types of the phonographs which Edison had made at that time, and also discloses in the last two sheets of drawings a variety of the various modifications which he had used in his experiments in the development of the art. In the drawings, Figs. 1 and 2, illustrate the general character of phonograph instrument referred to by Edison in his patent, No. 200,521, as being embodied in his application which subsequently issued as patent, No. 213,554, and to which I have previously referred.

Various modifications are shown in Figs. 6 to 11, illustrating different ways of mechanically feeding the recorder and reproducer over the record tablet, in the character of machine, illustrated in Figs. 1 and 2. Figs. 12 to 15 illustrate the other type of the Edison phonograph in which the cylindrical drum is employed about which to place the record tablet, and upon which a helical record groove is formed. This type of machine more nearly corresponds with the type illustrated in his American patent, No. 200,521. "Defendants' Exhibit No. 3."

Referring first to the former of these types of machines, there is a turntable, d, moved by a suitable motor about a vertical axis, so that the turntable revolves in a horizontal plane. The turntable has cut into its upper surface a spiral groove core, which corresponds, in effect, to the helical groove upon the cylinder of his U. S. Patent, 200,521. There is also an extension 3 of that spiral groove, toward the centre of the turntable, as suggested in his automatic telegraph patent No. 213,554, before referred to. Upon the turntable is stretched and clamped a sheet of tin foil, or other suitable material, forming the tablet, which may have a hole in its centre, so as to leave the inner spiral 3, uncovered. There is an arm, i, which extends radially over the turntable, and is pivoted at its outer end upon a horizontal pin, 5, carried in a head, pivoted by a vertical pin, 6, upon a suitable standard, the said pivots making a perfect universal joint for the arm. This arm carries at its free end a mouth piece with a diaphragm

and style, and since the arm can freely swing horizontally, over the surface of the table, the style can always be made to be exactly over some portion of the style groove, 4. Connected with the mouth piece or extending from the arm, i, is a short lug or arm, g, which carries a guide pin or style intended to engage the spiral groove, 3. When the pin engages the spiral groove, 3, the style on the diaphragm engages the spiral groove, 4, or the tablet which may be resting over said groove; and since these two spirals are extensions of each other, and, therefore, have the same pitch, it follows that as the turntable is rotated, the arm is swung over the table by the groove, 3, acting upon the pin which engages it, the style on the diaphragm will, at the same time, be over a corresponding portion of the spiral groove, 4. The arm, i, is carried down upon the turntable by its weight, so that the style of the diaphragm rests upon the tin foil or tablet by gravity.

A sound record is made by this machine by rotating the table, and speaking into the mouth piece, and said record is in the form of a spiral groove, of the same character as that produced in the Edison machine of his patent, No. 200,521, namely, one in which there are sloping side walls terminating in a bottom having a vertically undulating record. When reproduction is desired, the arm, i, is lifted and swung back, the style is put into engagement with the beginning of the groove, and the table is rotated as before. In this case, a small horn, in the nature of a speaking trumpet, is placed over the mouth-piece, so as to intensify the sound. This class of machine, as well as the one employing the revolving cylinder, were manufactured by Mr. Edison and reference to one of these machines will be found in "Defendants' Exhibit, No. 21," which is an extract from Du Moncel's work entitled: "The Telegraph, Microphone and Phonograph," on pages 247, 248, of which are illustrations of the machine. In these machines, the record tablets or sheets, are removable and exchangeable, and the machine is especially designed with this object in view.

In describing the operation of this machine, Edison uses the following language :

"The phonograph is upon a lever arm, 1, pivoted at 5, to a vertical stud, 6, so that the phonograph may be raised or lowered vertically, or moved horizontally for a purpose hereinafter explained.

"It is now to be understood that if a person speaks with his mouth near the mouthpiece of the phonograph the sound vibrations will act upon the diaphragm, and vibrate it, and communicate to the indenting point a similar movement, and that if a piece of metal coil or other material susceptible of being indented is placed beneath or behind the indenting point and caused to move regularly, or the indenting point move over the material that said material may be indented and for a perfect record of the sound vibrations * * *.

"The material upon which the record is made may be of metal foil, such as tin, iron, copper, lead, zinc, cadmium, or a foil made of composition of metals.

"Paper or other materials may be used, the same being coated with paraffine or other hydro-carbons, waxes, gums or lacs, and the sheet so prepared *may itself be indented*, or the material, say paper, may be made to pass through a bath of hot paraffine and then between scrapers. Thin metal foil is now placed on the material, and the sheet passed through rollers, which give it a beautiful smooth surface. The indentations can now be made in the foil, and the paraffine or similar material, and the indenting point does not become clogged with the paraffine, in consequence of intervening foil."

The part of the above matter, beginning with the words "the material" will be found at line 24, on page 7. I understand these two latter paragraphs to describe types of the record tablet which may be used. The first is the tin or other foil, which is indented in the manner well known in the early phonographs of Edison. The second is a tablet composed of paper with a coating of paraffine, or other hydro-carbons, waxes, gums, or lacs, leaving a waxy surface which "may itself be indented." The third type of record tablet is one in which paper is coated by passing through a bath of hot

paraffine, and after being scraped smooth, is coated with a very thin metal foil, such as tin foil, to give an exceedingly smooth surface, so that while the indenting record style shapes the record in the wax, it is kept out of immediate contact with the wax by the smooth metallic coating. This particular character of tablet is also referred to in Edison's patent, No. 200,521. I understand that the second character of tablet is one in which the recording style ploughs its way through it in making the record groove, whereby a groove would be formed having sloping side walls and a vertically undulating record at the bottom. That the indenting point or style is a cutting style and produces in its effect an engraving action is evident from the fact that Edison speaks of the possibility of it clogging with the paraffine, this result taking place owing to the fact that at that early date he had not arrived at a perfect composition in the form of a wax which could readily be engraved without more or less adhering to the engraving style of the recorder. It was immaterial to him how he produced his vertically undulating sound record so long as its configuration was correct, and, owing to the sticky tendency of the wax then employed by him there was more or less tendency to clog the engraving point or style, and he, therefore, largely used the layer of thin tin foil, through which the shape of the wax could be mechanically formed under the operation of the diaphragm.

It will thus appear that the record tablet which Mr. Edison proposed was one having a backing of paper or cardboard, coated with wax, or a waxy substance, and having the record engraved or gouged therein on a spiral or helical line, the said record having sloping side walls and an undulating bottom, and being adapted to receive and operate upon a style of a reproducer or "phonet" of less size than the engraving or recording style which formed the groove "so as to follow the bottom of the depressions without contact upon the sides." The said construction being substantially the character of records later disclosed in Complainants' Patent, No. 341,214, of 1886, in suit, and substantially of the character employed

in the present modern records, especially in view of the fact that Mr. Edison specifically describes that these wax records may be made in the form of a cylinder. This is also more positively apparent when we bear in mind that Edison's early work involved the use of stearine as a waxy component and this substance is very largely the basis of the present metallic soap records found in commercial use, both by the Gramophone Company and the Graphophone Company, the Complainants here in suit. In connection with the use of stearine, I would call attention to the article found in "Engineering," printed in England, April 18, 1879, p. 327, describing a phonograph of M. Lambrigot, said article being entered in this case as "Exhibit No. 19," wherein reference to the use of stearine by Mr. Edison is made in the following language:

"It is only fair to Mr. Edison, the inventor of the phonograph itself, to point out that the plan of producing a phonogram on a stearine surface * * * were suggested by him long ago * * *."

From which it will appear that in the early work of Mr. Edison, due credit was given to him for the employment of this most important article in the production of an engraved wax record.

To avoid a misunderstanding as to the meaning of the words indent and indented as used by Mr. Edison in describing the character or form of his records, I would say that the term "indented" is in full accord with the idea of cutting or engraving when applied to the article produced.

Adjourned subject to further notice.

PHILADELPHIA, Feb. 11, 1901.

Met Pursuant to agreement.

Present: C. A. L. MASSIE, of Counsel for Complainant.

HORACE PETTIT, Esq., of Counsel for Defendant.

(Mr. Hunter resumes:)

The terms "indenting," "indentations" and "indented" used by Mr. Edison in his patents refer to the record of the

sound or sounds formed on the tablet. Webster's dictionary defines the word "indent" as "to notch," "to jag," "to cut into points like a row of teeth." "Indented" is defined as cutting the edge into points or inequalities like teeth," "jagged" "notched," "stamped in," "dented on the surface." "Indentation" is defined as a "recess or sharp depression in any surface." It will be seen from these definitions that when applied to the variety of surfaces of the tablet such as employed by Mr. Edison in connection with pointed styles or recording points, the said terms would include the cutting or engraving as well as the embossing features. In the case of the use of tin foil unsupported by the employment of grooves under it, the irregularities were produced by embossing, but in the cases where paper was used in the manner specified in the Scientific American article of November 17, 1877, and more particularly where the tablet was "coated with paraffine or other hydro-carbons, waxes, gums or lacs," and directly subjected to the action of the recording style as specified in Edison's English Patent, 1644, the tablet was unquestionably cut, gouged or engraved into the proper irregularities to produce the record of the sound, "other hydro-carbons" found on line 27, page 7 of the English patent, would include a large variety of waxes and resins of various degrees of hardness, and which if used separately or in connection with paraffine, might be employed to produce a tablet of the desired solidity and brittleness to answer the requirements of a suitable record. I understand that Edison's patent does not limit him to any particular specific tablet, but is specially drawn to designate a composition tablet which may be either embossed or engraved.

Referring again more specifically to the construction of machines shown in this English patent, to Edison, No. 1644, of 1878, it will be observed that in Figures 6. to 10 inclusive, Mr. Edison shows other means for producing a mechanical feed of the lever, i, across the tablet, and these are such a construction that there is absolutely no support for the reproducing head and lever other than the record itself, so that the

reproducer rests by gravity or floats, as it were, upon the surface of the record, being sustained thereby through the medium of the style, which traverses the grooves. Referring to these figures the patent states :

In Figures 6 and 7 the shaft e projects above the surface of the disc, d, and there is a tooth upon the shaft contiguous to a rack bar extending from the phonograph, hence each revolution of the shaft, the rack bar, and phonograph will be moved the space of one tooth, consequently the lines of indentation will be parallel and concentric to the shaft e, excepting at the places when the tooth acts to move the rack bar and phonograph outward or inward * * *."

"In Figure 8, a worm upon the shaft, e, acts upon a worm pinion to revolve the shaft e, 5, and the worm at the other end of the shaft, e, 5, acts upon teeth around the base of the lever i, on the stud 6. By this device the phonograph will be moved outward gradually, and the line of indentations will be in a spiral, corresponding to the continuous spiral groove in the plate d.

"In Fig. 9, the shaft, e, is made with a fusee P¹, and one end of a swinging arm connected to the phonograph takes against the same. The spirals of the same gradually move outward the phonograph, as the disc and shaft are revolved, and the lines of indentations will be spirally the same as that made by the spiral 3.

"In Fig. 10, the shaft e, is provided with a screw pinion meshing with teeth upon a cam wheel 7. This gives the same movement to the phonograph as the spiral groove, 3"

Either of these modifications of the feeding mechanism may be employed in lieu of the pin and spiral groove of Figs. 1 and 2, and it is evident that in these constructions, 6 to 10, there is absolutely no support whatever for the reproducer except that which is secured by the style travelling in the record groove. Reference to Fig. 9, shows the reproducer, a, floating upon the tablet on the disc or turntable, d, since there is no support for this reproducer except by the style. The connection between the reproducer and the fusee, p¹, is by "a swinging arm" which is loosely pivoted to one side of

the reproducer head and has its free end loosely sustained by the fusee, so as to follow down its spirals by gravity without in any manner supporting the reproducer head in a vertical direction. At most it simply causes the reproducer head to travel horizontally, as the turntable revolves.

At this time, I would briefly refer to the fact that the various mechanical constructions of this Edison patent, 1644 of 1878, have been largely embodied in the mechanism shown in the Bell and Tainter patent in suit, the only difference in the general arrangement being that in the Edison case the feeding was mostly done to the reproducer, whereas, in the Bell and Tainter machine, the record was made to travel and the reproducer held substantially stationary, which difference is an immaterial one, in view of the fact that Edison's patent discloses both of these methods. The spiral groove tablet, with a floating reproducer, and means to produce a relative travel radially between the tablet and reproducer, shown on Sheet 1 of the Edison patent, is embodied in the machines of Sheet 1, 2 and 3, of the Bell and Tainter patent. The particular mechanism for producing the relative feeding between the reproducer and tablet, shown in Fig. 8 of the Edison patent, is the same mechanism which is shown in Figs. 12, 13 and 14 of the Bell and Tainter patent. The mechanism shown in Fig. 35 of Edison patent, and described as follows :

" Fig. 35 represents a phonet in which the phonogram containing a sentence, speech, words, or other sound record is upon a belt or strip wound upon a reel; this belt is drawn along gradually and wound upon the second roller by any suitable mechanism, and as the phonogram is thus moved, it actuates the phonet, c, b,"

is shown in Figs. 18 and 19 of the Bell and Tainter patent. It thus appears that the general mechanism of the patent in suit is substantially the same as that of the English patent, and, moreover, operates in connection with a tablet of the same construction, namely ; paper or cardboard coated with a waxy substance, and having the record grooved formed in substantially the same manner, while the Bell and Tainter

patent feeds the record as distinguished from feeding the reproducer. I would direct attention to Sheet 2 of the Edison patent, and especially Figs. 13 and 14, wherein the record tablet is placed upon the cylinder q, and which, while being rotated, is fed along in the direction of its axis so as to produce a record groove in a helical form, and which helical record is subsequently employed to operate a reproducer or phonet. Figs. 12 and 15 of the Edison patent, show the same general character of machine employing a helical record groove, but in which the reproducer or phonet is caused to be fed, while the record tablet is revolved. It thus appears that Mr. Edison considered these types as interchangeable and as embodying substantially the same general features, it being necessary that there shall be a relative movement between them, but it being totally immaterial which of the parts are caused to be mechanically fed.

Recess.

(Mr. Hunter resumes.)

I point out this similarity between the Bell and Tainter construction and the Edison patent at this time because I will, later on, take occasion to more specifically make comparisons between this Edison patent and the Bell and Tainter mechanism in connection with the claims involved in this suit.

Referring specifically to the drawings, Figs. 12 and 15 of the Edison patent, I find that the patent states:

"Instead of the sheet of metal foil being upon the disc d, it may be wrapped upon a cylinder q, as in Fig. 12. In this case the cylinder is upon a shaft e¹, revolved by gearing at h¹ * * * The phonograph is secured to a sliding shaft l¹, and said shaft is moved endwise back and forth by the screw k¹ acting upon an arm, m² that is secured to said shaft l¹. As the phonograph is moved in one direction the line of indentations is made spirally in the foil on the cylinder tube. * * * This feature is especially available for a phonet where the surface of the cylinder q is formed of an electrotpe or other copy of the phonogram. * * * In Fig. 15

the phonograph is fitted to move horizontally, instead of the cylinder *q*, as in Fig. 12, but the shaft *e*¹ is provided with a screw thread in one direction only, hence the phonograph has to be positioned by hand after the arm *o*¹ has been raised from the screw *k*¹.

In Figs. 12 and 15 the phonograph can swing upon the shaft *l*¹ to raise the indenting point from the cylinder *q*, and allow the removal or insertion of a sheet of foil, and there is a stop 8 for adjusting the position of the phonograph when brought down to indent the foil."

I understand this to be a description of the character of machine in which the cylinder rotates and carries the phonogram or record tablet, as employed in the modern machines, and that the phonet or reproducer is caused to travel over the surface of the phonogram or tablet by a screw feed and is at the same time loosely pivotted so as to have the reproducer constantly capable of moving to or from the phonogram or tablet. It enables the reproducer to be swung away from the record for changing it when desired, and if there is any eccentricity in the surface of the record such eccentricity acting through the style will cause the reproducer to float, or ride upon the record by gravity. It will be observed that the reproducer arm stands in an upright position, being pivotted, on the shaft *l*¹ at the bottom, and carrying the reproducer or phonet *a*, at the top precisely on the plan indicated in the Bell and Tainter patent, that is to say, the reproducer is carried on a pivotted arm held in an obliquely upward position and the style of the reproducer rests upon the record. This same idea of pivoting the reproducer by means of an arm so as to press it upon the record and permit it to have a floating action, is also very clearly shown in Edison's American patent, No. 227,679, of 1880, entered in this case as "Defendants' Exhibit No. 6," and to which I will have occasion a little later to speak more fully.

I would also direct attention to Fig. 27 of this Edison patent, which shows both the recorder and the reproducer operating in connection with the record. In connection with this, the patent states :

"Fig. 27 represents two instruments in connection with the cylinder q; in this case the phonet and phonograph are separate. The phonograph records in the usual manner, but the phonet has its diagram set in motion by the rise and fall of the lever e. This reduces the scraping noise of the foil and acts by leverage, and a slight tension to move the diagram as the phonogram is moved beneath the point c."

I understand this to be a construction in which the style point c is carried upon a lever or arm is attached at its opposite end to the diagram of the reproducer, the construction being such that the style is permitted to float to follow the irregularities of the record groove. I find further reference to this construction on page 2, line 53, as follows:

"I find that an arm at right angles to a diaphragm, with a point resting upon the phonogram, will reproduce the tones by the weight and leverage of the arm moving the diaphragm."

The patentee does not limit himself to any special character of material for the diaphragm, preferring a lighter diaphragm for the phonet or reproducer than that of the recorder or phonograph. On page 9, line 45, he refers to the use of "parchment or similar material" and again, in his prior British Patent No. 2909, of 1877, entered here as "Defendants' Exhibit, No. 32," he also refers among other things, to parchment (p. 2, line 11) and to "elastic materials" (p. 6, lines 12 and 13), and it is therefore evident that if the diaphragm b, of Fig. 27, were thus made of parchment or rubber, we would have a reproducing style supported by the reproducer with great flexibility, and with every capacity for both vertical and lateral adjustments to follow the record groove which, as I have before pointed out, is one have sloping side walls and a vertically undulating record at the bottom. Such a style as this just considered, would certainly track the groove and ride down the side walls to follow the record in case of any slight irregularities in the record. We would also have in this construction a style, or

reproducer, floating or operating under the action of gravity to follow the record, and, on account of the great extension of the lever e^2 , the style proper may be said to project in a sense beyond the instrument or head so that the position of the point of the style on the record may be readily seen. What I have above stated is true without regard to the particular character of means for supporting the reproducer head, as this may be in this case supported in fixed bearings, as in the case of Fig. 35, wherein the record tape is caused to travel under the style or in the constructions of Figs. 13 and 14 where the record travels under the reproducer or phonet. It is quite evident that this floating style may also be employed, if so desired, in the construction shown in Figs. 12 and 15, in which the reproducer would be carried by a pivoted arm and with the style of the particular construction illustrated in Fig. 27. In this case, however, the stops 8, in Figs. 12 and 15, would prevent the reproducer head from actually striking the record, and would, therefore, not put upon the style c , lever e^2 , and the diaphragm any material weight. The similarity of this construction of floating style to that of Figs. 7 to 10, and Fig. 20 of the Bell and Tainter patent will be apparent. It will also be observed that this construction of reproducing style and head embodies a mounting for the style which leaves the style free to move laterally and thereby adjust itself automatically to a sound record. Moreover, the construction is such that it is a reproducer having a rubbing style loosely mounted so that it is free to move laterally and thus adjust itself to the record groove of the tablet or phonogram. The said record or phonogram having its record groove formed as an irregular groove with sloping walls, and formed, if preferred, in wax or a wax-like material. In this Edison patent, not only is the wax or wax-like material fully set out as the substance from which the record tablet or phonogram may be made, but it also refers to numerous methods of reproducing this record, so that copies can be made in other materials. As one method of producing such copies the patent states :

"In copying phonograms, or making duplicates, an original phonogram may receive a deposit of copper or iron in a plating bath, and if of iron, may be carbonized or converted into steel when hardened, and then the same should be backed up with tight metal and used for impressing strips or pieces of metal.

"A bed of gutta percha, or similar material, may be used to sustain the sheet metal while being pressed. Numerous copies of the original phonogram can thus be reproduced."

If such a reproduced record in hard material, such as gutta percha were employed, it is evident that the results of reproduction of sound might be readily secured with fine results even where the diaphragm of the reproducer were of more firm material, and with the possibility of a heavier pressure of a style upon the record, since such reproduced records would be practically indestructible. Fig. 27 shows a decidedly long lever, supporting the style, but it is quite evident that this lever might be very materially increased if so desired, and the longer the lever, or arms e^2 , the more freedom will the style have for lateral play to follow any irregularities of the record groove, and it certainly will at all times have full capacity for adjusting itself or any eccentricities of the record.

Before leaving this English Patent No. 1644, of 1878, I would say that the drawings of said patent has been materially reduced by the photo-lithographic process employed, and, consequently, many of the figures seem quite small and difficult at first glance to readily understand. I, therefore, produce a set of drawings identical with those of the patent, but drawn on the original scale, which will undoubtedly be more readily understood in connection with the Edison British specification. These drawings, I understand, will be referred to in this case as "Defendants' Exhibit, No. 35."

Before referring to the prior art, other than that of Mr. Edison, I will take occasion to refer to Edison's Patent No. 227,679, of May 18, 1880, entered in this case as "Defendants' Exhibit, No. 6." In this patent it is stated :

"In my present invention, as in my former patent, the motion of the recording surface may be derived from clock work, hand, or other power. * * *

And again: . . .

"The cylinder A has a grooved surface, as in afore-said patent, and it receives the tin foil or other material that is to be indented by the action of the diaphragm b and point to produce the record of the sound, which I term the 'phonogram,' and the diaphragm E and point D are adapted to form a phonet to reproduce the sound. * * *

"With this character of instrument it is preferable to have the cylinder A upon a vertical shaft, and the sleeve and small diaphragm will be moved vertically. For this purpose the fixed stud 28 is vertical, and upon it is a tube 29 of a size to receive the sleeve t, and having a groove and key by which the sleeve t is allowed to slide endwise of the tube 29; but the two can be turned together on the shaft or stud 28. An arm, 30, on the tube 29, and a spring, serves to turn the tube, the sleeve, and the diaphragm and arm with sufficient force to bring the point B to bear upon the coil with the required force."

In this patent Fig. 1 shows the reproducer as stationary relatively to the record, and the record and its cylinder supporting it caused to travel under the reproducer, while at the same time rotating, similarly to Figs. 13 and 14 of the English Patent No. 1644, while Figs. 3 and 4 show the type in which the reproducer is caused to travel over the record, corresponding to the construction shown in Figs. 12 and 15 more particularly and also embodied in the general construction of Figs. 1 to 10 of the Edison English Patent No. 1644. In the present consideration we are more particularly interested in Figs. 3 and 4, because in this case we have the general character of phonograph used in the more modern machines, namely, a rotating record tablet of cylindrical type and a travelling frame or arm carrying the reproducer, and the reproducer pressed against the cylindrical surface of the record tablet, and made to float thereon under a light pres-

sure so as to follow all irregularities or eccentricities thereof. Figs. 3 and 4 show the vertically mounted record cylinder A, operated by a suitable clock-work mechanism contained in the box at the base of the machine. The lower part of the cylinder A is provided with a helical screw thread S. Arranged to one side of the record cylinder is an upright tube, 29, which is sleeved upon an upright shaft, 28. Upon the tube 29 a sleeve T is arranged to slide vertically so as to have a vertical motion independent of the tube 29, but rotating with it by means of a groove and key connection indicated by dotted lines in Fig. 3. The sleeve T carries an arm at the free end of which is the reproducer, having the reproducing style D. The tube 29 is provided with an arm, 30, to which is connected a spiral spring for causing it to rotate in such a manner as to tend to turn the reproducer against the record cylinder with an elastic pressure, the said pressure being adjustable by a suitable screw for putting the spring under tension. The sleeve T has along one side of it a rack 25, which is adapted to fit against the helical screw S on the record cylinder. The diaphragm holder of the reproducer being rigidly connected with the sleeve, will thus be propelled parallel to the face of the cylinder, and the style of the reproducer will be just opposite some portion of the helical groove on the cylinder and will operate in the indented surface of the tin foil or record tablet upon the said cylinder (previously subjected to a recording action), with the result that the recorded sound will be reproduced during the upward travel of the style and diaphragm. The patent states that the spring operates to turn "the diaphragm and arm with sufficient force to bring the point D to bear upon the foil with the required force." This I understand to be an operation of the reproducer, which will cause it to directly press upon the record groove of the tablet and be sustained against the action of the said spring wholly by the record, so that, as a matter of fact, it is a floating reproducer, guided upon the surface of the record to compensate for all eccentricities in the same by the record itself.

The screw rack 25 being so close to the pivot of the reproducer, a reasonable amount of play between the said screw rack 25 and helical screw S will permit all of the necessary movements of the reproducer head, without in any manner interfering with the proper operation of the reproducer as a floating element. While this machine has the record cylinder mounted on a vertical axis the invention illustrated would not be changed if the machine were turned on its side, namely, upon the upper right-hand side of the clock-work box or case (Fig. 3). In this case we would have the reproducer mounted on an arm, the latter being free to turn upon a horizontal axis and to float upon the surface of the record under the action of gravity supplemented, if desired, by a spring. As the reproducer arm is moved laterally over the face of the cylinder, we have a mechanical feed to produce this motion, thereby obviating the necessity of any universal joint in the said reproducer arm which would give to the reproducer a capacity of itself to travel transversely across the record, such, for example, as employed in Figs. 1 and 2 of the Edison English Patent No. 1644. The particular construction employed in this Edison Patent No. 227,679 more nearly resembling the construction shown in Fig. 15, of the Edison English Patent No. 1644, is the full equivalent of the other construction shown in Figs. 1 and 2 of the said English patent, in which the universally jointed arm is employed for carrying the reproducer, but in which a positive, mechanical feed is also employed for feeding the reproducer transversely over the record, with a step by step or gradual motion.

In all of the Edison machines, to which I have referred, the feed screws or feed spirals have a fixed relation to the helical or spiral record grooves. In the machine corresponding to his United States patents, the feed screws are rigidly connected and may be in one piece with cylinders, upon which the helical groove is formed and along which the record groove is made. In the machines of the character shown in his English patent 1644, the feed spiral is on the same disk on which the spiral groove along which the record

is made, is formed. In this patent he also shows constructions in which the feeding screw either for the cylinder or for the reproducer are also carried by the cylinder upon which the record is formed. Thus it will be seen that the relation between the feed and record is, in all of these cases, invariably fixed. Consequently, whatever disagreement of pitch there might exist in these machines, between the feed and record, the same can always be made as small as modern mechanical skill will permit. At any rate, these differences are invariable; that is to say, they are always the same and do not change from moment to moment, or from day to day. These discrepancies, such as they may be, are exceedingly small. There is practically no difficulty when reproducing from a record which has been previously made upon the machine and has not been removed, and neither would there be any difficulty in a properly constructed tablet such as disclosed in the Edison English patent, where the same is reinserted in the machine, and positioned by proper perforations and pins, but in the more modern machines wherein the cylindrical record tablets are made in quantities and sold as commercial articles for use in other machines, upon which they never were originally made or used, it is quite evident that when such cylindrical tablets are pushed upon the cylinder of the machine the position of the record grooves cannot be readily adjusted to come into exact alignment with the reproducer style, and, in this case, more or less difficulty of the style tracking the record groove has been experienced in the development of the phonograph as a commercial machine, and it is in this direction that the Bell and Tainter patent in suit discloses modifications or improvements over the construction shown in the Edison patent, the essential features of which they employ in the construction of their machines. I will have occasion, later on, to speak of these possible improvements, but will say at this time that while the general constructions shown in Mr. Edison's complete machines disclosed in his patent did not make

specific provision for this possible incorrect placing of the reproduced record, upon the record carrier or cylinder, he nevertheless, did have provision as I have before pointed out by his construction shown in Fig. 27, and by the employment of the modified form of feeding devices shown on Sheet 1, of his English patent, 1644, which would permit, under proper operation of his apparatus, while maintaining the mechanical feed, the style automatically adjusting itself to the record groove, and maintaining its position within the groove, even under the slight displacement thereof from what should have been its normal position, the extent of such displacement under no conditions being more than a fraction of the width of one record groove. While this width, in the early Edison machines, was considerably greater than that of the more modern machine, which latter is $\frac{1}{100}$ of an inch, it nevertheless was not of such magnitude that any serious difficulty would arise on this account, when employing the advantageous constructions illustrated in his several patents.

Adjourned until 11 A. M., Tuesday, Feb. 12, 1901.

PHILADELPHIA, Feb. 12, 1901.

Met pursuant to adjournment.

Parties present as before.

Examination of witness, RUDOLPH M. HUNTER, resumed.

(Mr. Hunter continues:)

Before leaving the Edison patents as evidence of the extensive research and very complete disclosures to the world of practical constructions for the commercial production of a gramophone, requiring only some good common sense and exercise of mechanical skill, to create from the disclosures in his several patents in publication a commercial machine, I wish to refer more particularly to some of the features of his style supporting devices since questions relating to this particular element are involved in this controversy. I have shown by "Defendants' Exhibit, No 34"

that the modified Leon Scott phonautograph, which is in the Institute of Technology at Boston, and was used by Professor Bell and others in 1874, embodied in its construction a flexible diaphragm combined with a long lever, one end of which is hinged to the frame carrying the diaphragm and the other end projecting beyond the said frame, at the opposite diameter of the diaphragm, and carrying the style point, the said lever being connected intermediate of the style point and its hinge and nearer the latter than the former, to the center of the diaphragm by a solid connection, which may be also termed a rigid connection so far as elasticity in the direction of its length is concerned. This in addition to the older types of Leon Scott phonautograph, which employed a long flexible style, directly connected to the centre of the diaphragm, were the known constructions prior to the development of the Edison phonograph. The type of phonautograph last above mentioned, is shown substantially in Fig. 15 of Edison's English Patent No. 2909, of 1877, "Defendants' Exhibit No. 32." In this Edison English Patent of 1877, we find in Fig. 8 a construction in which the style *a* is connected to a long lever or arm attached at its other end to the centre of the diaphragm. Under the style is moved the record. We have here a style greatly projecting beyond the diaphragm or reproducer, so that it can be seen, and free to have universal movement, which diaphragm is stated, in the patent, as being of very flexible or elastic material if so desired.

Fig. 6 of this same patent also shows another form of reproducer style in which we have the style connected to the end of a spring of great flexibility, the other end of which is rigidly connected with the reproducer head, and the free end of the spring back of the style connected with the diaphragm in the rigid or non-compressible manner. Moreover, this style is shown as operating in connection with a vertically undulating record formed by a previously engraved paper strip.

Fig. 5 is an elevation of this same apparatus, and the patentee refers to these two figures as follows:

"The paper after being indented, is passed through a second apparatus, n, Fig. 5, almost similar to h. A spring 9 has a knife edge which rests upon the raised indented rib 6, the spring being connected to a delicate diaphragm 10, by a string or straw."

It is quite evident that in this construction, by the employment of a straw between the centre of the flexible diaphragm and the free end of the spring, we have a reproducing device embodying a style and diaphragm upon which the reproduced sonorous vibrations are to be impressed by the said style, combined with a flat metal spring interposed between the style and diaphragm and forming a yielding connection through which the reproduced vibrations are transmitted, said spring having a practically rigid connection with the diaphragm. We also have a similar construction shown in the reproducer m, of Fig. 29, from which it will be seen that the spring is interposed between the style ~~point~~¹² and the diaphragm, the connection with the diaphragm and interposed between it and the spring being shown as a solid substance such as the straw before referred to in connection with Fig. 6. The construction shown in Fig. 29 is almost identical with Fig. 6, but is shown in connection with a record tablet on an Edison phonograph machine, and in which the record groove is helically arranged about a cylinder tablet, and is formed with sloping side walls, and a vertically undulating record at the bottom of the walls, the combination, therefore, being substantially the same as that employed in the later machines developed by Bell and Tainter, and more particularly evidenced in the Tainter Patent No. 341,288, of 1886, in suit, and especially illustrated in Figs. 11 and 17 for example. The Edison patent refers to Fig. 29 as follows:

"A convenient form for the sound recorder or phonograph is to employ a cylinder 61, see Fig. 29, having a helical groove in its surface covered with tin foil, and the cylinder is revolved by clock work, and moved endwise by a screw on its shaft, so that the indenting point.¹¹ from the diaphragm 10 of h, will be always in line with such groove, hence the vibrations of

the diaphragm will be recorded by indenting the foil into the groove, and hence the same sound will be reproduced by the point l^2 of the hearing instrument, n , giving to the diaphragm of n , the motions that result from the indentations of the foil moving in contact with such point.

"The foil may be on a flat groove plate and be indented and act as before named."

It will be noted that the types of the phonograph above referred to stated as being used with the particular character of reproducer, are those also fully shown in Edison's later patent, 1644, of 1878, "Defendants' Exhibit, No. 11" and to which I have before referred at considerable length.

Turning now to the Edison English Patent 1644, of 1878, "Defendants' Exhibit, No. 11," Fig. 27 shows, as I have before pointed out, a type of reproducing style so flexibly connected as to be capable of universal movement in all directions, and thereby have full capacity to follow the record groove. The construction shown in Fig. 22 is one in which the style point is connected on a free end of a spring e^2 , which is directly connected with a diaphragm b , and with an elastic cushion between the body of the spring and the centre of the diaphragm. This construction shows the employment of a style directly and solely carried by the diaphragm, more particularly as illustrated in Fig. 20 of the Bell and Tainter patent, 341,214, in suit; and if the said style were slightly extended on the principle of the phonautograph at the Institute of Technology at Boston, "Defendants' Exhibit, 34," we would have the form of reproducer style illustrated in Figs. 7 to 10, of the Bell and Tainter patent in suit, the extension in my judgment being merely a matter of mechanical skill, or the exercise of good judgment. In connection with this I would refer to Fig. 18 of this Edison patent, in which the style point c , is shown as located practically to one side of the diaphragm and substantially at the perimeter of the reproducer, thereby indicating that a similar location of the points in Fig. 22, would not involve invention. In the particular illustration shown in Fig. 1, the style point

c, is attached to the free end of a delicate spring, e^2 , which spring is hinged by an arm with the reproducer arm i of the phonograph. With regard to this construction, the patentee states :

"The diaphragm is made of a thin sheet of iron or other material, and it is preferable to place the indenting point upon a delicate spring arm e^2 and to employ a piece of rubber tubing, e, between the spring and diaphragm; this rubber acts as a damper to prevent false vibration of the diaphragm."

It is thus seen that we are directed to employ a *delicate* spring for carrying the style point, and it is also noted that the connection of the spring or its support is hinged to the arm i, and, moreover, the connection between the spring and the diaphragm is very flexible, being a small piece of rubber tubing. Of course it is evident that some rigidity might be given to these parts, but it is also evident that reasonable looseness or flexibility would be a natural result of their construction, and if such flexibility and looseness is employed, it seems to me, without the least exercise of the inventive faculties, the said style would have sufficient elasticity in a lateral direction, to adjust itself to record grooves, especially where the record grooves are only of 1-100 of an inch, as in the more modern machines. This adjustment would also be very easily accomplished where the style point was at considerable distance from the diaphragm, as, for example, in Figs. 8 and 15, 6 and 29 of Edison's English Patent No. 2909, of 1877, and Fig. 27 of the patent under consideration, namely, No. 1644. Especially is this true in a machine that has a mechanical feed, that is to say, positive means for feeding the reproducer over the record or the record under the reproducer, and in which the displacement of the record in its readjustment to the machine could never displace the record groove out of its proper position relative to the style, more than a fraction of the width of the groove under any conditions.

Turning now to the Edison Patent No. 200,521, "De-

defendants' Exhibit, No. 3," I find that the reproducer is described as follows:

"In front of this diaphragm is a light spring D, having a small point shorter and finer than the indenting point on the diaphragm of B. This spring and point are so arranged as to fall exactly into the path of the indentations. This spring is connected to the diaphragm, F of C, by a thread or other substance capable of conveying the movements of D. Now, when the cylinder is allowed to rotate, the spring D is set in motion by each indentation corresponding to its depth and length. This motion is conveyed to the diaphragm either by vibrations through a thread *or directly by connecting the spring to the diaphragm F.*"

It will thus be seen that from this description the connection between the free end of the spring and the diaphragm and in alignment with the style point, may be directly or positively connected in lieu of the string or thread, thus disclosing a construction of reproducer style and diaphragm combined with a flat metal spring, interposed between the style and diaphragm and forming a yielding connection, said spring having a practically rigid connection with the diaphragm.

Recess.

Of the improvements set forth in the Edison Patent 227,679, "Defendants' Exhibit, No. 6," there should be particularly pointed out those illustrated in Figs. 5 and 6, which represent combinations of record cylinders with recording and reproducing styles. In Fig. 5, the recording and reproducing style is formed at the free end of a lever which, between its free end and a pivot, is connected with the diaphragm. This construction is almost identical with the Leon Scott phonautograph, shown in "Defendants' Exhibit, No. 34." With this construction, if it is used as a reproducer, the vibrations of the style will be transmitted to the diaphragm with reduced amplitude. In the construction shown in Fig. 6, one end of the lever is pivoted and the other is

connected with the diaphragm, and, intermediate between these two points, is the style bearing upon the record. With this construction, if used for reproducing, the vibrations of the style will be transmitted to the diaphragm with increased amplitude. Mr. Edison emphasized this part of his invention in the specification, in a paragraph extending from line 90 on page 1 to line 7 on page 2, as follows:

"Another feature of invention relates to a lever between the diaphragm and the phonogram, whereby the relative movements of the parts may be varied. This lever, e, has a fulcrum at 15. If the connection to the diaphragm is between the point d, and the fulcrum 15, as in Fig. 5, then the motion of the point will be greater than the diaphragm, and when used in the phonograph will amplify the indentations in the foil. If used in the phonet, the movement of the diaphragm would be lessened. I, therefore, prefer in that instrument to change the places of the point and diaphragm connection as shown in Fig. 6, so as to amplify the movement of the diaphragm and increase the sound."

Levers of all descriptions were well known in the art whether the same was straight or bell cranked, and there was no exercise of the inventive faculties required in specially locating the arms of the lever in one direction or the other. In these constructions of Mr. Edison, the lever has in effect two arms, namely, a long arm and a short arm, one of which carries the style and the other is connected to the diaphragm. In the particular illustration these two arms are superimposed, as it were, because from the relative arrangement of the direction of action of the style, and the plane of the diaphragm, the lever arms are naturally brought in alignment. The construction would, however, be precisely the same, so far as operation is concerned if the diaphragm were set at an angle and the lever arm connection with the diaphragm were arranged at an angle to the lever carrying the style. Such a self-evident modification would make the two armed lever a crank or bell crank lever, more nearly resembling the crank lever style 93 of the Tainter Patent No. 375,579, of 1887, in

suit, but the function and operation of the lever is precisely the same whether under this form or under the straight form illustrated in Figs. 5 and 6 of the Edison patent. As I understand the Edison structures, they combine with a diaphragm of a reproducer a rubbing style structure consisting of a lever having the rubbing point or style proper formed on one arm, and the other arm connected with the diaphragm, and this is true in my judgment, irrespective of the fact that the two arms of the lever extend to the same side of the fulcrum and happen to be in alignment.

The described reproducing device in Cros's sealed paper deposited with the French Academy and found in the "Comptes Rendus" a copy of which is entered as "Defendants' Exhibit 15" should also be kept in view when considering the particular style operating devices, since it has great pertinency with respect to Claim 44 of the Tainter patent, 341,288, in suit. This part of the Cros apparatus is described as follows:

"A metal point, if the tracing is in grooves (or a notched finger, if it is in relief), is held by a spring on this tracing, and at the other end the finger which supports this point is solid with the centre of the surface of the suitable membrane for producing the sounds. In these conditions, this membrane will be animated, no longer by the vibrating air, but by the tracing commanding the pointed finger, by impulses exactly alike in duration and intensities, to those which the registering membrane were subjected."

It will be noticed that this language is very clear, and fully discloses a construction very similar to that found in the Edison English patent of 1877, before referred to, namely, a finger having a point at one end and positively connected with the diaphragm at the other end, and a spring holding this finger and necessarily connected to it at its free end intermediate of the point and the diaphragm, the said construction embodying the combination of a style point and diaphragm of a metal spring interposed between the style and diaphragm and forming a yielding connection, through which

the reproduced vibrations are transmitted, said spring having a practically rigid connection with the diaphragm, thereby answering the requirements of Claim 44 of the Tainter patent, 347,288, in suit.

While Mr. Edison was extensively developing the art of the reproduction of sounds, others were also interested and were making investigations employing apparatus, involving some of the essential features and characteristics of good reproducing apparatus, and as this art is more or less important in this case, I will briefly refer to some of it.

On March 7, 1879, was published in "Engineering" (London, England), Vol. 27, pages 200 to 202, an article entitled: "The Examination of Vowel Sounds," by W. H. Preece and Augustus Stroh, in the synthetic examination of vocal sounds, being a paper read before the Royal Society in London. Extracts from this article, together with illustrations, are entered as "Defendants' Exhibit, No. 33." Briefly stated, the illustration, Fig. 1, shows a recording device for producing a record of sound waves, the apparatus consisting of a tubular glass lever pen g, through which an aniline ink flows, arranged to be operated by a flexible diaphragm somewhat conical, which is connected to the lever pen or style intermediate of its point and its fulcrum. By means of this, a record was produced very much on the plan of the old phonautograph. However, I would call attention to the fact that in this construction we have the lever mechanism very similar to the construction shown in Fig. 5 of Edison's patent 227,679, "Defendants' Exhibit, No. 6." By means of the instrument shown in Fig. 1, accurate tracings or records of sonorous vibrations, and especially the vowel sounds, were secured upon a travelling paper strip. The paper then goes on to describe a mechanism for producing irregular tracing by mechanical means, first to demonstrate the fact that the tracings produced under the action of the apparatus of Fig. 1 was caused by the combination of certain fundamental prime sounds, and certain upper partials for the vowels. It then shows that by preparing certain disks in ac-

cordance with these mechanically prepared curves, the operation of said disks upon a reproducing diaphragm caused the repeating of the vowel sounds; the paper, therefore, was one of analysis. In the present case we are simply interested in the floating reproducer and floating recorder described and illustrated in these papers to show that a gravity actuated device of this character was well known in the art long prior to the date of any improvements in this direction by Bell and Tainter.

. Referring to the apparatus, Figs. 2 and 3, the recording style of pen is shown at Q, and supported at the free end of a lever O counterweighted at W. This lever traces upon a traveling record surface R, which is moved under the pen or style. The lever O is pivoted on a transverse axis at the upper end of the lever P, which latter is pivoted at p. This lever P is pulled in one direction by a spring S, to move the style transversely to the left, and is pulled in the opposite direction to move the style to the right by a complicated series of devices shown at the right-hand portions of these figures 2 and 3, the details of which it will be unnecessary to enter into. However, under the action of these devices, and the spring S, the lever P is rocked, and the recording style is caused to travel transversely on the record surface simultaneously with the record surface being fed forward under the action of the traveling bands T. While this is taking place, the pivoted lever arm O presses the recording style down upon the record surface with a delicate pressure under the action of gravity. With regard to this construction the article states:

"This lever is pivoted at p, and by means of the spiral spring S, keeps the levers, links, and silk threads in a state of tension. On the longer ends of the lever P, is pivoted another lever O, which carries at its shorter end a small counterbalancing weight W, and at its longer end a glass pin, Q, containing suitable ink. On the table R is placed a piece of paper or smoked glass, which is held there by two spring clamps."

After describing the adjustment of the mechanism to operate this device, the article continues:

"The crank-like movement of the rod B^1 will by means of the silk thread b^1 , roller N^1 , levers U , V , and O , cause the pin Q to move to and fro with simple harmonic motion, while the table R will move longitudinally, the pin thereby writing upon the paper a simple harmonic curve."

I understand this to describe a mechanism which, while especially designed for recording, discloses clearly the idea of a style carried at the free end of a pivoted arm, and pressed upon the record by the action of gravity. If in place of using a record by ink the record were to be made by a diaphragm and style for indenting or cutting into the record surface, or for reproducing the sound from a previously prepared record, as fully disclosed in the Edison and Cros patents, the said diaphragm would be carried on the free end of the lever O and would constitute a floating gravity actuated reproducer. It would involve no invention to employ the said gravity actuating idea of causing the style to move over the record surface with slight pressure illustrated in this publication in a reproducing device of a phonograph and while this floating reproducer was also shown in the Edison patents, the delicate adjustment indicated in this publication was, perhaps, not so fully followed out. The idea was the same in kind, however, though different, perhaps, in degree.

The construction shown in Fig. 9 of this publication, is also interesting in that it shows a cylinder upon the periphery of which is arranged the record or sound curvatures, these being formed on the peripheries of a series of disks carefully cut from the records produced by the above mentioned apparatus. This record cylinder is caused to be rotated by hand. Immediately below and parallel to the cylinder is a guide rod, upon which is pivoted an arm carrying the reproducer head which is provided with a flexible diaphragm, and a projecting style, adapted to be brought into

contact with the periphery of either one of the disks. The pivoted arm is counterweighted as shown. By means of this mechanism, the style may be brought in front of either one of the disks desired, and by the counterbalancing of the arm and reproducer, it will be maintained under gravity action against the said record disk, so that in effect it is a floating gravity actuated reproducer. This apparatus has no means for automatically feeding the reproducer longitudinally, nor has it got helical records, as in the case of the Edison machines, but this was not necessary as it was only intended to reproduce from any one disk a definite vowel sound, and it was desirable to repeat the reproduction as often as desired while the speed of revolution of the disk was changed. With regard to this part of the apparatus, the article states :

"In the hope of getting more perfect definition, another machine was now made upon which disks were fitted, whose peripheries were cut in exact copy of the curve produced by the synthetic curved machine. These curves were transmitted by vibration to a receiving diaphragm of a phonograph, really forming an 'automatic phonograph.' The automatic phonograph consists of an axle A, Fig. 9 (see p. 202), about six inches long, one end of which carries a fly-wheel B, and the other end a grooved pulley C, round which a band or gut passes from a driving wheel D, fitted with a crank handle E. On rotating the driving wheel, the long axle was caused to make about three revolutions to one of the wheel.

"On the long axle are placed, in such a manner that they can be easily removed and replaced by others, a number of brass wheels or disks, a, a, a, a, the circumferences of which have been cut by a machine specially devised for that purpose into different curves corresponding exactly to the curves obtained by the synthetic curved machine, but on a much reduced scale.

"A diaphragm G with spring and frame H, similar to that in a phonograph, is so fitted that it can be shifted from one disk to another, and the sounds produced by the different curves can be readily compared."

It appears, therefore, that in this article of 1879, "Defendants' Exhibit, No. 33" we have another disclosure

in prior art of a gravity actuated reproducer with freedom to follow any surface irregularities, while not in any wise affecting the action of the record itself upon the diaphragm through the style.

"Defendants' Exhibit, No. 18," is another example of a knowledge of the early work in phonographic reproductions, to which the attention of the public is directed, and is a publication in "The Telegraphic Journal," printed at London, Feb. 1st, 1879, Vol. 7, page 53, in which the following is found :

"The Abbe Carbonal concludes that the recording and rehearsing diaphragm should be distinct, the former having a very sonorous plate operating on a very stiff, hard foil, the latter a delicate membrane like that of the ear. The foil could be made from a copper band thinly coated with wax to take the impression, and corroded afterwards by acids so as to obtain a hard metal cast; but this is necessarily a defective process. The Abbe, therefore, employs albumen spread upon paper or other base instead of wax applied to the copper. The soft albumen record is afterwards hardened in a well-known manner, and a hard matrix, whose dints vary in depth with the intensity of the sound, is obtained. As a means of reproducing the sounds, he suggests the use of Sabarts' wheel instead of a vibrating plate."

While this article does not very clearly describe the ideas of the inventor, it indicates that he proposed to produce sound records upon elevated ridges as the desirable thing though his first preference was to an etched strip of copper.

Shortly after the appearance of Edison's phonograph, Lambrigot produced a cheap type of phonograph described in "Engineering," Vol. 27, page 326, April 18, 1879, a copy of which article is here in evidence as "Defendants' Exhibit, No. 19." In the finished apparatus of this inventor, the records are made upon parallel strips or bars of lead, by a reproducing process. Briefly stated, the record is first cut in a bar of stearine wax by means of a recording apparatus comprising a diaphragm and style, and this wax record is then

reproduced by an electrotyping process and the electrotype employed for reproducing lead records, which are subsequently used in connection with a reproducing instrument of unique design. The reproducer is simply a cone of pasteboard whose apex is connected with a lead wire to the centre of a pasteboard disk, which latter is rubbed over the record surface of the lead wire,

"each of which bears upon its upper surface a phonograph embossed record corresponding to a certain word or sentence."

After pointing out the uniqueness of the general construction, especially of the reproducer, the article continues:

"The most interesting point connected with this very simple apparatus is the method by which the leaden records are produced, which is as follows: The upper surface of a rectangular prism of glass or other hard and rigid material is thickly coated with stearine wax, which is then scraped into a convex form, as shown in the diagram, Fig. 2, in which a represents the glass bar and b the convex coating of stearine. This bar is then fixed into a simple phonographic instrument, which, by means of a screw, or other mechanical contrivance, traverses it at a suitable speed below a diaphragm. This diaphragm is rigidly held around its circumference by an annular frame work (not shown in the diagram), and is in every respect exactly similar to the diaphragm of an ordinary phonograph. To the centre of this diaphragm is attached a thin flat plate, whose lower end is cut out to a concave curve, to fit the convex surface of the stearine. b. When all is properly adjusted, and the temperature is so arranged as to give to the stearine surface a proper degree of hardness to insure the best results, the handle of the instrument is turned, and at the same time words are spoken against the diaphragm, which immediately set up in it vibrations, which are communicated to the plate or style. While this is moving up and down, following the vibrations of the diaphragm caused by the voice, the stearine coating of the bar, a, b, is steadily drawn in the direction of the arrow below the vibrating bar, receiving from it a phonogram similar to that produced on the tin foil of an ordinary phonograph."

It appears, therefore, that the tablet in this instance is a stearine wax tablet, and this is mechanically moved under a cutting style of a recording diaphragm and the raised surface of the stearine is directly engraved or cut to form the record. While, of course, this stearine wax record might be used with a reproducer, especially of the delicate type of the Edison patents to produce audible sounds, corresponding to those used when making the record, nevertheless such a record would not last long under such use, and especially not when used in connection with such a reproducer as that shown in the Lambrigot publication. Lambrigot, therefore, provides for duplicating the record by a cheap electrotyping and embossing process whereby duplicates of harder material may be readily produced. With regard to this duplicating process, the publication goes on to say:

"The stearine bar is then coated with a fine surface of plumbago, so as to give it an electrically conducting surface, and it is then electroplated with copper by the ordinary process * * * a firm copper-lined matrix or mould is formed, the whole presenting the appearance shown in Fig. 3, and consisting of a rectangular block having along the centre of one of its sides a semi-cylindrical groove of copper, c, which bears upon its surface certain raised striations corresponding to the depressions which were made by the diaphragm, on the surface of the stearine. Into this groove is laid a piece of lead wire * * * and the two being put into a press and squeezed together, the surface of the lead wire receives a permanent impression which is an exact reproduction of the original impression made upon the stearine bar."

After giving this description of the process of reproducing the lead records, the article gives the credit to Mr. Edison for the plan first of producing a phonogram on stearine wax, and, secondly, for the method of reproducing phonograms.

Recess until 7 P. M.

7 P. M.

About the same time an article appeared in the Journal of the Society of Telegraph Engineers, London, 1879, in Vol. 8, page 303, referring to the Lambrigot phonograph, and contains in connection with a general description of the apparatus substantially as above set out, a statement showing that the record was engraved. The words are :

"It consists, in the first place, of a lead wire upon which certain impressions are engraved. These engravings are produced in the following manner: The phonograph armed with a knife edge, instead of a point passing over a sheet of tin foil, passes over a bar of stearine. This bar of stearine receives the phonographic impression."

The article then goes on to point out how the lead records are prepared as duplicates from the engraved stearine record. This article shows that the idea of a vibrating style operated under the action of the diaphragm to engrave a record upon a wax tablet, was undoubtedly well known in the art at that time, and therefore, broadly speaking, there was nothing new in engraving a wax record at any subsequent time. It is true that this engraving was upon a raised surface, or ridge, but engraving both upon a ridge or in a groove having sloping side walls, were both accomplished by Edison as evidenced in his English Patent No. 1644, of 1878.

While speaking of the prior art, regarding the idea of engraving the phonographic record, I would refer to French Patent No. 135,688, dated March 20, 1880, issued to Charles Weyher, for an Improved in Continuous phonograph, the patent states :

"The phonograph, for which I formulate the present application for a patent. * * * is based in principle on the registering of the vibrations of a stylus on a fine wire of an indefinite length. * * * The wire when passing from one bobbin to the other, traverses a small anvil placed beneath the vibrating stylus, which is nothing but a small burin, the cutting part of which is perpendicular to the wire. * * *

"I desire by the present application for patent, to guarantee to myself the exclusive property of the system of phonograph above described, that is to say, a continuous phonograph the stylus of which, in the form of a burin, acts on a metallic or other wire and impresses thereon the vibrations to which it is itself subjected. *
* *"

This description shows a clearly defined conception and embodiment of an apparatus for engraving a record by means of a burin or engraving tool, and while the patentee's ideas was to engrave a sound record upon a wire, nevertheless if the record tablet were of any of the wax constructions specified in the Edison British patent, 1644, it would clearly and concisely engrave a record groove having vertically undulating irregularities of the character of the modern record. A burin is an engraver's tool, and is defined in Webster's Dictionary as "the cutting tool of an engraver on metal, used in line engraving. It is made of tempered steel, one end being ground off obliquely so as to produce a sharp point, and the other end inserted in a handle; a graver; also, the similarly shaped tool used by workers in marble. Second, the manner or style of execution of an engraver; as a soft burin; a brilliant burin." I have frequently used a burin or engraving tool of this character and am prepared to say very positively that if such a tool was employed to engrave a sound record in a wax or wax-like surface, employing it as a style, operated by a diaphragm in the manner set out in Edison's English patent, 1644, I would certainly produce a record groove having a vertically undulating bottom bounded by sloping sides or walls, and the record produced would be in all material respects identical with the record produced with the engraving tools shown in Figs. 5 and 6 of the Bell and Tainter patent in suit. It certainly would involve no invention to employ the engraving recorder of this French patent in connection with the phonograph of Edison as such would be merely adaptation and the substitute of one well-known equivalent for another; such substitution would not involve invention, in my opinion.

A United States patent, bearing upon this subject of the prior art, is that No. 287,166, dated October 23, 1883, to C. C. Reynolds for an improvement in phonographs. It illustrates the employment of a rotating cutter against which the solid record tablet is vibrated. That is to say, there is a rotary cutter, which maintains its position and there is the usual vibrating diaphragm with a point projecting against a longitudinally moving strip or record tablet, the vibration of the diaphragm through the medium of sound waves operates to bring the record tablet and cutting style into contact to a greater or less extent depending upon the amplitude of the sound vibration. A modification shows a solid record tablet in the form of a strip, passing between two rotating cutting styles, so that simultaneous records are made on both surfaces, of solid record material. The record, resulting from this operation is a sound record cut in a solid body, that is, a body of sufficient hardness to retain its shape after cutting. This patent shows another method of engraving.

The U. S. Patent, to Hall, No. 219,939, dated September 23, 1879, entered as "Defendants' Exhibit No. 5," shows an improvement in phonographs. This patent describes a form of phonograph as an improvement upon Edison's Patent No. 200,521, employing two record tablets, each of which contains a record groove operating upon a suitable lever through the media of two styles, the said lever being pivoted at or near its middle, and having its opposite end directly connected with the diaphragm of the recorder or reproducer. The apparatus shows in Fig. 3, two cylindrical tablets FF¹, which are simultaneously rotated and fed along by suitable screws; arranged above these rotating cylinders and tablets is the diaphragm A, stretched within the sound box C¹; secured to the centre of the diaphragm A is the lever G¹, which is pivoted at B, and has its free end projecting down between the two record tablets, and furnished with oppositely directed styles or points gg¹. The patentee states:

"It is not absolutely necessary to employ two

cylinders to produce the double or divided record. I have shown in the diagram, Fig. 4, a construction of the lever and points whereby a single cylinder may be used.
* * *

In either of these constructions we have in the apparatus the diaphragm of a reproducer combined with a rubbing style consisting of a lever having the rubbing point formed on one arm and the other arm connected with the said diaphragm. This construction being substantially that set out in Claim 20 of the Tainter Patent No. 375,579 in suit.

Before leaving this consideration of the prior art, I would refer to two very old patents, one being dated in 1863 and the other in 1860. The former of these is to Hayden and is entered as "Defendants' Exhibit, No. 2." This patent is for what is known as a Rose engine. It is a type of engraving machine in which an engraving tool is caused to automatically engrave an article in a manner to correspond to the tracing of a style or point over a previously prepared model or record. Referring to this patent, there is a shaft a, journaled in bearings b, and upon one end of that shaft is secured in any suitable manner, the article, d, to be engraved. Upon the other end of the shaft is secured the pattern or record to control the engraving. The shaft is provided with a screw thread p; working with this screw thread is a half nut g, attached to a slide f, adapted to be moved parallel to the shaft. In this slide is pivoted a frame, h, carrying at one end an engraving tool, n, for engraving the article, d, and at the other end a suitable style, o, or point which traces upon the surface of the record or pattern. A spring, m, operates to draw the frame, h, forward so as to keep both the style, o, upon the pattern or record, and the engraver style, n, upon the article to be engraved, d.

It will now be seen that, by rotating the shaft, a, the engraving tool will engrave the article in exact accordance with the tracing of the style o, upon the pattern or record. We have here a spring actuated or floating tracing style,

tracing a spiral course over a record, and we have a similar engraving style engraving a helical or spiral groove on a tablet or article to be engraved of cylindrical form. There is considerable similarity in this apparatus to the mechanical feeding devices of the phonograph.

The other early patent, is that to Pease, No. 27,827, of 1860, entered as Defendants' Exhibit No. 1." This patent is for an engraving machine and comprises a lazy tongs lever carrying a hand controlled style G, adapted to be moved over a pattern or record N, and also provided with an engraving style or cutter, j, adapted to operate upon the surface of a tablet M. The lever carrying these styles is pivoted upon a suitable standard upon transverse pivots, e, and upon a vertical pivot, f, so that it has capacity for universal movement. This shows the employment of a floating lever pivoted on a universal joint, and adapted to have its style caused to follow a record groove, thus showing that at this early date, the idea of a universally jointed support for a style to enable the style to follow the irregularities of a record groove, was well known in the art.

Referring to "Defendants' Exhibit, No. 21," I find it to be an extract from the publication entitled "The Telegraph Microphone and Phonograph," by Du Moncel, published by Harper Brothers, A. D. 1879, pp. 247-248. This article is essentially a description of the character of machine shown in Figs. 1 to 10, of the Edison English Patent No. 1644, of 1878, "Defendants' Exhibit No. 11," and more particularly with the feed mechanism for the reproducer arm of the character indicated in the modification. In other words, the spiral groove, 3, of the English patent for feeding the reproducer arm transversely across the revolving turntable and tablet, is not employed, but, in lieu thereof, suitable feeding devices are arranged within the case, and operate upon the vertical shaft 6, which carries the head in which the lever is pivoted. It will, therefore, appear that in the illustration of the Edison phonograph, in this publication, the reproducer arm is perfectly free and is a floating or gravity actuated arm supported

at its free end by the style resting upon the record. The arm is pivoted on a universal joint. With regard to the mechanical feeding in this machine of the publication, I find the following language:

"In this new model, the plate on which the tin or copper sheet is to be applied has a spiral grooving, of which one end corresponds to the centre of the plate, and the other to its outer edges. The plate is set in motion by a powerful system of clock work, of which the velocity is regulated with reference to the length of the turns of the spiral. The vibrating disk arranged as in the former instrument, and placed above this plate; the tracing point may, by means of a movement of progression imparted to the system, follow the spiral groove from the centre of the plate to its circumference."

It is thus clear that no provision is made for feeding the reproducer and arm transversely by means of a spiral groove on the turntable, but, instead, the entire surface is given up to producing a record in the form of a spiral and the feeding mechanism or means for imparting "a movement for progression" is arranged within the box and operating as above pointed out.

Another publication which has a material bearing upon the issues here involved is the publication known as "Nature," published July 4, 1878, and a copy or extract from which, taken more particularly from Vol. 18, p. 249, is entered in this case as "Exhibit No. 20." This article refers to the phonograph and shows a cross-section of a reproducer. This reproducer consists of a mouthpiece back of which is stretched a very flexible diaphragm. Attached to the frame carrying the mouthpiece is a very thin flexible spring, having at its free end the reproducing style or point, and also connected with the diaphragm by a rigid rod or connection of wood. Immediately below the illustration, and as descriptive of it, I find the following words:

"A small rod of light pine wood having a rubber pad at either end is placed between the box which carries the embossing point and the center of the mem-

brane. This, the first form of disc construction, worked very well."

I find in this construction disclosed in "Exhibit No. 20" a reproducer style and the diaphragm or device upon which the sonorous vibrations are to be impressed by said style, combined with a flat metal spring interposed between the style and diaphragm and forming a yielding connection, through which the reproduced vibrations are transmitted, said spring having a practically rigid connection with the diaphragm, the said construction embodying the essential characteristics of the invention of Claim 44 of the Tainter Patent No. 341,288, in suit.

In conclusion of this consideration of the prior art I will refer to a striking article which appeared in Scribner's Magazine for April, 1878, at page 855, relating to the Edison phonograph and to its possible future uses, and a portion of which I will here quote.

"The sheet of tin foil or other plastic material receiving the impressions of sound will be stereotyped or electrotyped so as to be multiplied and made durable, or the cylinder will be made of a material plastic when used and hardening afterwards. * * * Having provided thus for the durability of the phonograph plate, it will be very easy to make it separable from the cylinder producing it and attachable to a corresponding cylinder anywhere and at any time. There will doubtless be a standard of diameter and pitch of screw for the phonograph cylinder. Friends at a distance will then send to each other phonograph letters which will talk at any time in the friends' voice when put upon the instrument. * * * Certainly within a dozen years some of the great singers will be induced to sing into the ear of the phonograph and the electrotype cylinders then will be put into the hand-organs of the streets, and we shall hear the actual voice of Christine Nilsson or Miss Carey ground out at every corner. * * * It will supersede the shorthand writer in taking letters by dictation and in the taking of testimony before referees. Phonographic letters will be sent by mail, the foil being wound on paper cylinders of the size of a finger."

This rehearsal of the various uses to which the phonograph and its reproducible records may be put is instructive as it includes practically all of the uses to which the graphophone of the complainants is alleged to be applicable. It will be noticed that in this article that it is contemplated that while stereotyped and hard metal reproductions and duplicates of the original shall be made and used, the original may also be used with the reproducer for rendering the record audible in the manner hereinbefore pointed out.

It is stipulated by and between counsel for the respective parties that the foregoing quotation from Scribner's Magazine for April, 1878, is a correct copy of the part quoted, and may be used with the same force and effect as though the original publication were herewith produced as an exhibit.

Adjourned until 11 A. M. Wednesday, Feb. 13, 1901.

PHILADELPHIA, Feb. 13, 1901.

Met pursuant to adjournment.

Counsel present as before.

Q. 7. Please consider the Bell and Tainter Patent 341,214 in suit. State your understanding of the nature of the invention disclosed therein, and the relation of the same to the prior art. In this consideration you may refer to the deposition of Mr. Cameron, if you so desire.

A. The Bell and Tainter patent in my opinion is a mere modification of the structures disclosed in the prior Edison patents, and whether such differences as may exist between the said structure of the Bell and Tainter patent in suit, and those of the Edison patents in the prior art, involve the exercise of the inventive faculties, and rise to the dignity of an invention would be better understood after considering the said patents mentioned in the prior art. In a general way, I might say that the only material difference which I find between the structure disclosed in the Bell and Tainter patent

and those of the Edison patents constituting a large part of the prior art, is the interposition between the carrying and pivoted arm upon which the reproducer head is placed, and the head itself of a universal joint capable of giving to the style an exceedingly small additional capacity for movement, especially in a lateral direction, to compensate in a mechanical feed machine for any slight displacement of the record groove under the style irrespective of the particular cause of said displacement; the said universal joint having a capacity for permitting the style to move laterally to the extent of approximately the width of a record groove so that it may readily adjust itself to the bottom of the groove and properly track the same while the main weight of the reproducing arm carrying the head, together with the head and the various connections, is supported upon an additional transverse hinge support, and the record as an entirety, together with its support, is moved mechanically and positively past the style of the reproducer with a speed with that necessary to approximately keep the record groove of the tablet always under the style. Of course, if we are to assume that the Bell and Tainter apparatus is limited to one in which the reproducer head is not mechanically fed or caused to travel over the record, as distinguished from feeding the record transversely under the reproducer, then there could be no question of infringement. For this reason, I will assume that in view of the prior art, it was immaterial with the invention of the Bell and Tainter patent, whether the record was fed transversely under the reproducing style, as shown in their patent, or whether the reproducer was mechanically fed transversely across the record, as is done in the modern phonographs of Edison and of the complainants, the Graphophone Company. Briefly stated then, the novel feature which I find disclosed in the Bell and Tainter patent in suit is one in which there is a positive mechanical feeding mechanism for imparting a definite and regular transverse feeding of the reproducer relatively to the record tablet to approximately keep the style of the reproducer in alignment

with the moving record groove, and the employment in such a machine of an additional device adjacent to the reproducer which shall give to the reproducer and its style a capacity for a slight lateral motion, or a universal motion, to prevent the possibility of the mechanical feeding mechanism keeping the style out of contact with the bottom of the record groove, or forcing it out of that groove after it has once tracked the same. This is the novelty which I find disclosed in the patent and which is made the subject matter of claims 20, 21 and 23.

Having thus stated briefly, I will proceed to consider the structure of the Bell and Tainter patent more fully. I have shown at considerable length that the idea of engraving a record, whether the said record be on metal, paper, or wax, was fully disclosed in the prior art, and, consequently, the broad idea of engraving a wax record was not new at the date of the Bell and Tainter patent, but, while it was not new, and left no room for invention broadly in this direction by Bell and Tainter, it nevertheless had not met with much favor because of the liability of the wax surface to be easily destroyed by use with a reproducer. In the early phonographs, it was thought more desirable to directly use the sound record originally produced for reproducing, and this was very largely the practice with the Edison machines, and, consequently, in such uses tin foil was usually the substance upon which the record was made. The art of engraving in a phonograph, and the employment of wax-like compounds, was so fully disclosed in the prior art, that mechanical skill alone was necessary to practice the formation of engraved records in such surfaces, and while there was no invention possible, in broadly engraving a record at the date of the Bell and Tainter patent, it did not follow that they might not evolve an improvement in the reproducer which might be so delicate in its action as to permit the use of such wax record without material danger of the style leaving the bottom of the record groove and ploughing its way through the side walls to the destruction of the record in case the mechanical

feeding mechanism persistently forced the relation of the style and record groove out of that which theoretically they should assume, whether this was due to eccentricity, displacement of the record in the machine, or the production of what is termed "drunken" record grooves, namely, those which are not strictly theoretical, helical, or spiral grooves. This capacity of the reproducer, to enable its style to find the bottom of a record groove, adjacent to which it is placed by the mechanical feed mechanism, and without the capacity of the machine being capable of dispensing with the mechanical feed, is the sole novelty which I find in the Bell and Tainter patent over that of the prior art. In view of the fact that the Edison early machines, which were brought to the notice of the public in practical form, usually employed tin foil as the record tablet, it is proper that I should compare with such a record the record of the Bell and Tainter patent for more clearly pointing out the nature of the Bell and Tainter invention, which was especially and solely useful in connection with a record in wax or wax-like material.

The wax record described in the Bell and Tainter patent, in that it is formed by elevations and depressions, in the bottom of a *very shallow* groove, gouged out from or engraved in a body of wax-like material, as is distinguished from a record formed by indenting or embossing the tin-foil. With a tin-foil record, the groove is relatively much deeper and wider than the groove in a wax record, and, consequently, on a given area or surface, less words can be recorded. In view of the fact that the tin-foil is a thin sheet, and the groove is formed by stretching or bending the said sheet over the spiral ridges on the surface of the record cylinder, there was a practical limit to the closeness of these grooves, as there was danger of disturbing a previously formed record groove by the formation of the next one, or rather, a continuation of the helical or spiral groove on the next revolution. Bell and Tainter recognized that the tin foil record was, therefore, not capable of taking as many words as practice would demand,

and, consequently, turned their attention to that part of the prior art which involved the use of the wax engraved records, which permitted them to engrave a very fine groove into the surface of such a wax-like substance without fear of disturbing or distorting the preceding part of the groove. The formation of a record in this manner enables the grooves to be very close together; and, in the modern practice, they are placed so close together that the edges of one groove coalesce with the edges of the next adjacent groove. Because of the possibility of adjacent grooves, in a wax record, to be very fine, without disturbing the configuration of each other, during their formation, and also because of the heavy work necessary the grooves are made very much shallower, thereby permitting a very long record groove upon a very limited surface. There was nothing new, however, in this, because the employment of all the appliances and apparatus for producing such a record were clearly disclosed in the prior art, and especially in the Edison English Patent No. 1644, the degree of fineness of the grooves being solely regulated by the shape of the point or style and the fineness of the thread on the feeding screw or spiral which produced the relative movements between the record tablet and the phonograph or recording instrument, and this could be made as fine as desired without involving invention. Whether or not Bell and Tainter thought that they had made an invention broadly involving the idea of engraving a wax record, the fact remains that the prior art discloses that at the date of their invention there was no room for a patentable invention of any such scope, but it is possible that the prior art was not so fully known to them, or to the Patent Office at the early date of the Bell and Tainter patent, as it has been shown to exist in my brief summary of the said prior art. I would point out that, in the Bell and Tainter patent, they refer to the prior art as follows:

"Heretofore the vibrating style has, as in Edison's well-known phonograph, simply indented the recording material. It has been proposed to cut the record in

the edge of a strip of metal or other solid material, by vibrating the strip in contact with the cutting edge of a rotary disc cutter."

The latter reference is no doubt to the subject matter of the Reynolds patent, "Defendants' Exhibit No. 8." That this quotation does not disclose the real art as it existed prior to Bell and Tainter's invention, with regard to the prior art, is clearly shown by my previous answer. Immediately following that statement of the prior art the patentee says with regard to the engraving method, alleged to have been developed by them :

"Under this part of the invention, are included the vibratory cutting style, as a new device in a sound recorder."

That there was no novelty in operating a cutting style or engraving is self-evident, from the numerous examples of cutting styles operated by diaphragms for engraving the record which I have pointed out in a previous answer. The patentees say that they form their sound record "by means of a cutting style," and they further say that the essential new feature of their invention is :

"The removal of material to form the record by a cutting, gouging, or graving action of the vibrating style."

They also say :

"In this new or improved form of record, may a larger number of words or sounds be recorded, in a given surface than has been practicable with the indented records heretofore in use, but the recorded vibrations are also sharper and better defined. It is found that an indenting style smoothes over the crease of the larger elevations, and also rubs out some of the finer ones." P. 1, lines 50-58.

The material which some of these inventors employ for the formation therein of sound records is a mixture of one part, by weight, of white bees wax, and two parts of paraffine.

This mixture is spread upon a sheet of cardboard and thus forms a "tablet," for the reception of the sound record. I have shown that a tablet of this character is fully disclosed in the Edison English Patent, 1644, which he says may be directly subjected to the action of the recording style, just the same as it is directly subjected to the action of the recording style in the Bell and Tainter patent. Even the particular character of cutting tool or style is fully disclosed in the French patent to Weyher, No. 135,688, of March 20, 1880, in which the burin or engraving point is set out as being operated by the diaphragm for engraving a record, the burin point having the same character of point as the graver or cutting style of the Bell and Tainter patent, and adapted for producing a record having a vertically undulating bottom and sloping side walls. In these latter respects, the record is identical with the Edison record, as I have before pointed out.

Recess.

As it is a matter of some interest in this case, what the particular size and construction are of the record grooves, I will consider them a little more in detail. It must be remembered that we have here to deal with a thing of very small size, namely, a groove in the commercial machine, which it would be useless to examine with the unaided eye. Still, Bell and Tainter speak in their patent of the different parts of that groove. They speak of the "sloping walls" of the same; also of the "bottom of the groove," and of "elevations and depressions" at the bottom; and they ascribe different functions to the different parts of that groove. This being the case, it will be well to have a thorough knowledge of the configuration of the record groove in order that the functions which the different parts perform may be understood. However, to study the said groove, it is necessary to resort to microscopic enlargements of the same. Naturally the shape of the groove will be dependent upon the engraving tool or style, which is to cut it, and this is illustrated in the patent by Figs. 5 and 6. The specification says :

"Figs. 5 and 6, views on the enlarged scale of the engraver or cutting style;"

from which it will be seen that if the drawing thereby gave a graphical illustration of the cross-section of the groove, it does not, however, give any information with respect to the *size*, since there is nothing to indicate how much Figs. 5 and 6 are enlarged. However, referring to the specifications regarding the engraving style, we find, on page 3, lines 67-76, it is described as follows:

"The latter is preferably formed of a round wire by turning the end conical and rounding the extremity, and then grinding off one side to the axis of the wire. This leaves sharp cutting edges on both sides of the tapering point. These edges remove the material in chips or shavings, like a plane or turning-tool. It is not essential to give this form to the style tool. Any form which will remove the material and not simply displace it will answer."

Again, on page 4, lines 19-23, I find

"a penetration of $\frac{1}{100}$ of an inch has been found very effective, the style being formed of No. 16 wire shaped at the cutting end as in Figs. 5 and 6."

Even this, however, does not convey even an approximate idea of the configuration of the record groove that will be made by such a style, since nothing is said in the patent how, and to what extent, the pointed wire is rounded off at its end before being ground off one side to form cutting edges. While the exact shape can therefore not be mathematically determined, it is, however, certain that the rounded end of the style will produce a groove that will be, in effect, curved in cross-section.

Mr. Cameron, complainant's expert, in his answer to XQ. 65, says that the record groove disclosed in the patent has substantially the same form as the record groove formed on the commercial machines that are built and operated in accordance with this patent, No. 341,214, in suit. He says:

"In actual practice when sound grooves are cut or

engraved in a solid substance, in accordance with the specification of Patent No. 341,214, in suit, the groove varies greatly in width and is in cross section approximately in the form of an arc."

And in his next answer, namely, $\times Q. 66$, he says:

"The construction of grooves to which I referred in the first part of my last answer, is in exact accordance with the groove specifically defined in the patent, that is a groove with sloping walls."

Again, in speaking of the enlarged view of the cutting style shown in Fig. 6, he says, in answer to $\times Q. 75$:

"It must be born in mind, however, that the cutting portion of this style, being only about the one one-thousandth of an inch from the end thereof, is so small that the width of the groove to be cut thereby, in proportion to the depth, is very great and would, even with the somewhat crude outline shown on Fig. 6, give a groove which would be approximately arc-shaped in cross-section."

And again, in answer to $\times Q. 81$, he says:

"As I have repeatedly stated heretofore, the sound groove being in cross-section approximately that of the arc of a circle, I have no hesitation in stating that it is not necessary that the width of the reproducing style must be less than the average width of the sound groove."

From an examination of carefully prepared microscopic enlargement of the grooves of the commercial graphophones, I fully agree with Mr. Cameron in the view which he thus expresses. The exact width of these grooves are readily calculated when we ascertain that in the commercial record it is found that there are almost exactly one hundred record grooves to the inch. The maximum width of a record groove would, therefore, be one $\frac{1}{100}$ of an inch. The depth of this groove may be ascertained by a careful examination of the cutting style. From the testimony given in the *American Graphophone Co. v. The National Graphophone Co.* and *Frank Seaman*, in the Circuit Court for the Southern

District of New York, I find that the cutter is made of a jewel in cylindrical form having the end cut off almost at right angles to the axis, and that this cut off end is used as a cutting edge. Such a cutter would make an arc-shaped groove, a microscopic photograph enlarging the said cutter shows by means of the enlarge micrometer scale that this cutter has a diameter of almost exactly five one-hundredths of an inch. Since the groove is cut with this style, and has a width of one one-hundredth of an inch, it is easy to ascertain, by geometrical calculations, that the depth of the groove is almost exactly one two-thousandths of an inch, from which it is seen that the groove is only one-twentieth as deep as it is wide. A copy of each of the photographs, to which I have above referred, are entered in this case as "Defendants' Exhibit, No. 25."

While the above analysis of the cutting style will in effect determine the shape of the groove, the same was also ascertained by a microphotograph enlarged about thirty diameters, the said photograph showing a cross-section of the gramophone recording cylinder. This photograph is entered in this case as "Defendants' Exhibit, No. 23." This photograph shows the grooves well enough, but even with this enlargement they are so shallow that the eye is unable to fix upon any particular point and estimate its elevation or depression with reference to another point. The grooves are entirely too shallow for this purpose. To obviate this difficulty a drawing has been prepared which shows the grooves about two hundred times enlarged, and also shows clearly the character of the grooves regarding their width and depth. On the same drawing is also shown a similar cross section of another type of groove enlarged to the same extent, and to which I will refer hereafter when speaking of the grooves of the defendant's machine. The first mentioned cross-section of this drawing is marked "Graphophone Grooves," while the latter cross-section mentioned is marked "Gramophone Grooves." This drawing is entered as an Exhibit in this case as "Defendant's Exhibit, No. 26." An examination of this drawing of the gramo-

phone grooves will show that in cross-section the grooves occur and that the adjacent grooves coalesce to form intervening ridges, this being always the case if the grooves have their maximum width and depth.

While Bell and Tainter settled upon the character of grooves which they were determined upon using in their wax records, they were confronted by another problem, that is to say, the producing of satisfactory sounds from such records, it being borne in mind that to properly reproduce from the record the reproducing style must be actuated by the bottom or lowest part of the said groove, since that is the place in which the vertical undulations or records proper are formed. In the Edison machines with tin-foil records, as has before been pointed out, the grooves, though similar in cross-section, were materially larger; that is to say, wider and deeper, and also somewhat more widely spaced, so that there was not the great difficulty of insuring the reproducing style tracking the bottom of the record in a mechanically driven feed machine, as was encountered in the mechanically driven feed machine of Bell and Tainter, employing the record grooves on a much finer scale. In the tin-foil record the grooves are sufficiently perceptible to the eye, so as to permit the adjustment of the reproducing style, but not so in the case of the Bell and Tainter apparatus. Moreover, the wax record of Bell and Tainter being in softer material, was apt to be more readily injured or rubbed out if the style of the reproducer was not made to properly track the groove, since a defective location of the style relatively to the groove in a mechanical feed machine would cause the style to ride upon the walls of the groove, and, consequently, be improperly acted upon, and at the same time, in its effort to ride down the walls of the groove, it would be very apt to scratch or injure the formation of the groove. In any event, it is most difficult to secure any adjustment of a reproducer carried in fixed bearings, such as those at 20, in Figs. 1 and 2 of the Bell and Tainter machine, with a record having the minute grooves above pointed out, it being borne in mind

that the reproducer was not the instrument which originally produced the grooves. It is simply an additional element, which is turned into position by hand, and which, if not properly adjusted at the beginning of tracing the record, will never have a style in proper tracing position throughout the entire mechanical feeding operation, which produces the relative movement between the record and reproducer. The Bell and Tainter records being made in wax, they were dull and without lustre, and being at the same time so very narrow and shallow, it is practically impossible to secure any initial adjustment of the style to the bottom of the groove, and an attempt in that direction would be mere guess work, and, therefore, impracticable in a commercial machine.

It was because of this difficulty that Bell and Tainter found it advisable to introduce a small rubber support for the reproducer head, whereby the style of said head could have a slight lateral adjustability which would compensate for any mechanical displacement between the normal position of the style and the record groove, and thereby enable the style to slide down the sloping walls of the groove, until it tracks the bottom thereof.

"Defendants' Exhibit, No. 26" will give an excellent idea of the great difficulty which would be experienced in endeavoring to locate the style of the reproducer by hand adjustment upon the bottom or middle portion of so shallow a groove. The record, that is to say, the elevations and depressions from which good reproductions are obtained, are in the bottom of the groove. However, when speaking of the "bottom" of a groove which is as shallow as the gramophone groove, we cannot assume that it is a definite point, for, while the lowest point is the bottom, theoretically, we must assume, practically, that it would also include a portion of the groove to each side of the centre, and it is proper to take this view of the case when considering the term "bottom" as found in the Bell and Tainter patent, and when considering the elevations and depressions formed in said bottom. They must mean the centre of the groove and would possibly

include parts next adjacent to the centre. In this exhibit, No. 26, the centre is marked with a full vertical line, and a dotted line is arranged on each side of the centre line, and it may be assumed that Bell and Tainter's reference to the bottom of the groove would include the groove between the dotted lines. Between the said dotted lines and the ridges are the sloping walls, which are designed to guide the style down to the bottom. Of course these dotted lines have been arbitrarily selected by me but they are sufficiently close to the proper positions to locate the bottom for the purposes of the present consideration.

As Bell and Tainter employed a mechanical feed machine for moving the record transversely past the reproducer, and employed a different style for reproducing than the one which produced the record, they were confronted, therefore, with a problem which is at the basis of their invention, namely, how to maintain the use of a mechanical feed in their machine without necessity for fine adjustments thereof, or of the reproducer, and yet insure with a record having this extremely fine groove, that under all normal operations, the reproducing style shall seek and follow the bottom of the groove or that point between the two vertical dotted lines in Exhibit, No. 26, irrespective of the particular point of the groove which may be first touched by the style when turning the reproducer into operative position. Bell and Tainter also show a construction wherein the record tablet, F, may be clamped into position or removed from the turntable E (Fig. 1), namely by the clamping nut 2. It is thus seen that if a record is replaced in the machine, as was their intention, and the new record clamped thereon, there would be a tendency of the said new record to be somewhat displaced, so that its spiral groove would not be mathematically concentric with the axis of revolution, to correspond strictly to its position when it was made. Under this condition, it will readily be seen that while there will still be a spiral record groove, the said spiral will not be mathematically so located as to be caused to uniformly increase its distance from the centre of

revolution, but there will be, naturally, some slight eccentricity. However, as this eccentricity is a defect, and unintentional, and is not compensated for by the uniform mechanical feed, it follows that, without some slight additional adjustment of the style there would be a tendency of the said style to ride out of the bottom of the groove, and possibly over a ridge into the next groove, and back again, thereby not only interfering with the proper reproduction but also inducing great liability of injuring the record. This difficulty is entirely overcome by giving to the reproducer head or its style, a small capacity for lateral adjustment, independent of the mechanical feed. As the grooves are only one one-hundredth of an inch wide, it is evident that this possible lateral adjustment of the style would never be more than possibly one one-hundredth of an inch, and while present would hardly be appreciable to the eye. Of course I do not say that more eccentricity might not be produced than this, but it should not be produced in anything approximating a commercial apparatus, and would not in the modern graphophone machine, which employ a cylinder and a helical record groove, in place of a flat disc tablet, and a spiral record groove, such as shown in the patent.

Another cause which would necessitate either an accurate adjustment or the provision of some automatic capacity of adjustment of the style to the groove, even where the record tablet was positively and accurately adjusted to the centre of the revolving turntable, is that which would be produced by failing to clamp the tablet upon the turntable in exactly the same position which it had when the record was made. It is evident that if this record is adjusted circumferentially, that there is no place except one point in one revolution where the style could, as a matter of fact, be directly over the bottom of the groove. Any other position than this one would relatively displace the record groove to the style, and unless provision was made to induce the style to automatically adjust itself to the groove (within the extent of one one-hundredth part of an inch), the style would not

track the bottom of the groove and properly reproduce the sounds. Here, again, is a cause which induced Bell and Tainter to make their invention or improvement contemplating the support of the reproducer head or style with provision for slight lateral adjustment, without interfering with, and in addition to the employment of the definite uniform, mechanical feed.

Messrs. Bell and Tainter, therefore, devised means whereby the reproducing style might seek and find the *bottom* of the groove *automatically*, and might, from moment to moment, neutralize automatically any tendency of the style to leave the middle portion, that is to say, the bottom of the groove, where said groove is from any cause displaced from its true position, relatively to the style. All this appears from the patent here under consideration; but since the specification and drawings are perhaps not as clear as they should be, a closer reference to them will be necessary.

The patent describes and illustrates three kinds of machines, the first, in order of the sequence, is illustrated by Figs. 1 to 11; the second is illustrated by Figs. 12 to 17, and the third by Figs. 18 to 20.

First, referring to the machine of Figs. 1 to 11, we find that it comprises a disc or turntable E, revolved by a friction pinion G, turned by a handwheel 8. The disc E, by means of gearing 4, turns a screw 5, which works in a nut, 6, and thereby with each revolution, causing itself to be propelled transversely on a guide frame B past the reproducer or recorder, whichever may be in use. The record tablet F is as before stated, of a cardboard disc, coated with a mixture of paraffine and bees wax, and this is clamped in position upon the disc or turntable E, by the clamping nut 2. In consequence of the combined rotary and rectilinear movement of the disc, a fixed point or style bearing upon the surface of the table would inscribe thereon a spiral line or groove, the pitch or distance between the grooves being mathematically equal to the pitch of the screw thread on the screw 5 in the particular construction shown.

In front of the tablet is pivoted at 20, on an axis parallel to the disk, a sound conveying tube, 19, and upon this tube is a weight Z, which may be adjusted up or down upon the tube to increase or decrease the gravity action thereof. This tube is so pivoted that it will swing in a vertical plane at right angles to the plane of the tablet and disc.

For recording there is inserted in the tube 19, another tube 18, which carries at its free end the recording diaphragm and style. Sounds uttered against a suitable mouthpiece I, are conveyed to the tube 18 and 19, and act upon the diaphragm 105, and cause the cutting style 11 to vibrate. The weight Z is so adjusted upon the tube 19 that the style, resting by gravity against the tablet, will penetrate into the material of the same to a suitable extent, and when the style is vibrated by sound waves its penetration will vary in depth, and by reason of the rotation and rectilinear progress of the tablet, it will cut into the surface of the same a spiral groove with sloping walls, and having elevations and depressions in its bottom. These elevations and depressions in the bottom of the groove are vertically undulating and have sloping walls and constitute the sound record.

When it is desired to obtain a reproduction of the sound, the recording diaphragm and style are removed by drawing the tube 18 out of the tube 19. Another tube, 33, is then inserted into the tube 19, and the upper end of this tube, 33, is joined to the reproducer head, H, by a short piece of rubber tubing, 32, shown more particularly in Fig. 8. The reproducer head is provided with a projecting style, 26, and this style is caused to follow the record grooves previously formed by turning the arm, 19, with the reproducer head attached thereto, forward into position to bring the style against the record. Now, it is evident that even in making this transformation, from a recorder to a reproducer, it would be practically impossible to bring the two styles exactly upon the same place in the record, first, because the styles are differently positioned, and, secondly, the manner of adjusting the tubes to each other is liable to displace the relative posi-

sitions of the styles. Here, again, we find the trouble, even where the record has never been taken off the machine, to cause the reproducing style to follow the bottom of the record groove, and it is only by virtue of the fact that the reproducer K is now supported upon the little piece of rubber tubing, which acts as a small universal joint, that Bell and Tainter are enabled to cause the said style to track the bottom of the groove, the said rubber joint permitting the slight lateral movement or twisting, if necessary, of the head, to enable the style to adjust itself to the centre of this minute groove of one one-hundredth part of an inch in width. The capacity for adjustment is there, and comes into play even though the eye cannot conceive it. The effect of this construction is that when the producer is allowed to fall forward towards the record tablet, the style might, perchance, fall exactly into the bottom of the record groove; and if this happens the universal joint does not come into action, or material action at all. Even under this condition, however, had the record been substituted, it is possible that the eccentricity before spoken of would be present in the grooves, and upon turning the tablet, the lateral play would be accomplished by the rubber tubing, to enable the style to follow the bottom of the groove. It is more likely, however, in either case, that the style will strike one of the side walls of the groove, or the common ridge into which the walls of the two adjacent grooves coalesce. In the first case, the style will slide down the inclined wall of the groove, and, in the second place, it will fall from the common ridge down into one or the other of the two adjacent grooves, and, in both cases, the point of the style will settle in the bottom of the groove, when the same is moved under it.

It will be seen that, in order to reach the bottom of the groove, the style must be free not only to move forward at right angles to the face of the tablet, but, also, laterally parallel with the face thereof.

Adjourned until Thursday, Feb. 14, 1901, at 11 A. M.

PHILADELPHIA, Feb. 14, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of witness, R. M. HUNTER, resumed.

(Mr. Hunter continues his answer to Q. 7.)

The forward movement or the one at right angles to the face of the tablet is primarily accomplished by the hinged joint at 20, just as it is accomplished in the prior Edison machines. For example, the English Patent No. 1644, and the American Patents No. 227,679 and No. 213,554. This forward motion is, however, in the Bell and Tainter Patent somewhat modified by the use of the short rubber tube 32, adjacent to the reproducer head. This rubber is the sole means for allowing of the exceedingly small lateral adjustment of the head and style upon the hinged arm 18, 19, and is a movement which is wholly independent of the mechanical feed of the machine, which causes the positive relative transverse movement between the tablet and the reproducer.

This being the function of the universal joint, formed by the rubber tube, and there being a very gentle or slight slope to the sides of the groove, it is evident that there should be little, if any, resistance against the lateral movement of the reproducer and style, if the latter is to seek the bottom of the groove.

A short piece of rubber tubing if of sufficient flexibility, will offer practically no resistance to such lateral movement, since the extent of the movement required is at a maximum not more than one-half the width of the groove, that is to say one two-hundredth ($\frac{1}{200}$) of an inch, in the commercial machines given to the public. It is absolutely essential that there be practically no resistance to lateral movement offered by the rubber tubing, for if there be any appreciable resistance, the style could not slide down the exceedingly gentle slope of the wall of the groove. The specification of the patent is not as clear regarding this as it should be; in fact,

it is in many places objectionably obscure and indefinite, requiring reasonable interpretation, such as is afforded by the context and by common sense. Still, when the real invention of the patent is kept in mind, a tolerably clear idea of the function which is assigned to the universal joint afforded by the short piece of rubber tubing may be had. The patent says about the reproducer and its functions as follows:

"The invention consists, fourthly, in loosely mounting the reproducing style so that it can readily be guided by the record. Preferably the reproducing style or, rather what may be termed the "head" of the reproducing instrument, is mounted on a universal joint, and the style is pressed against the record by the yielding pressure of a spring or weight. Practically, in the instrument made by us, the pressure is due to the weight of the instrument, modified by the elasticity of a section of *soft rubber* tube, which supports the same and constitutes a universal joint; but evidently there are many devices which can be used to mount the reproducer so that it is free to follow the sound record or phonogram, and which, therefore, would be within the spirit of the invention. The reproducing style, mounted as just explained, is especially adapted for use in connection with a record in the form of a groove with sloping walls, and this combination is specially claimed; but it may also be usefully employed in connection with other forms of record." (P. 1, line 84 to p. 2, line 3).

And again, on page 4, lines 58 to 84, the specification states:

"The reproducer K when so placed is mounted upon a hollow standard, composed of the tubes or tubing, 31, 32, 33 and 19, and in consequence of the flexibility of the rubber tubing, 32, it is free to follow the record. No special care is necessary to insure its adjustment, for if the reproducer K be allowed to rest against the record with the style upon the engraved line the style will of itself gravitate to the bottom of the groove.

"There exists always a liability to disarrangement in some part of the machine either in the recorder

or the support therefore, or the recording tablet or its support, or if there be no disarrangement it would be difficult to insure that the reproducer style could cut the record precisely at the proper point if the reproducer be held rigidly. Difficulties on these accounts are avoided by the loose or flexible mounting of the reproducer, the style automatically adjusting itself to the proper place on the record. It will be seen that the reproducer is mounted on a universal joint, so that it can move in any direction. The movement parallel with the face of the tablet would, however, by itself, allow the style to follow and adjust itself to the record to a useful extent."

The above is a full quotation of all that is found in the specification of this patent regarding the function of the section of rubber tubing which constitutes the universal joint. It should be noted that the last sentence of the preceding quotation shows that the gist of this improvement is in enabling the reproducer head to have the slight lateral play or movement parallel to the face of the tablet, so that the style may have a capacity of movement equal to a fraction of the width of a groove, so that the style may adjust itself properly therein, it being understood that the hinging of the arm 19 in the bearings 20, in the old and well-known manner shown in the Edison patents, compensated for the other possible requirement of movement at right angles to the plane of the tablet. It is also to be noticed that in the above quotations it is specifically stated that the reproducer head is supported, or mounted, on the rubber tubing, showing that this improvement does not contemplate the elimination from the machine of the floating reproducer arm and reproducer head, in a machine in which there is positive means for mechanically feeding the record relatively to the reproducer head to bring the entire length of the groove of the tablet successively under the style of the reproducer head, but contemplates simply the addition of a flexible support for the reproducer head proper upon its arm to give the style of the reproducer head an additional small amount of adjustment which is independent of the mechanical feed, and

thereby insure the style getting to the bottom and tracking the bottom of any portion of the groove, which may, by the mechanical feed, be brought under the style of the reproducer. The improvement does not go beyond this. The function of the improvement is stated as follows:

"No special care is necessary to insure its adjustment, for if the reproducer K be allowed to rest against the record, with the style upon the engraved line, the style will of itself gravitate to the bottom of the groove."

This paragraph describes, very briefly, all of the uses of the universal joint of the patent. *It is the automatic adjustment of the style point to the bottom of the groove which the mechanical feed of the machine brings under it*, and which automatic adjustment within the sphere of approximately one two-hundredth ($\frac{1}{200}$) of an inch is secured by the universal joint which immediately carries the reproducer head. The universal joint in the Bell and Tainter machine does not permit the style to seek any groove or the bottom of any groove, except the one which by means of a mechanical feeding mechanism, is brought to the style. In the particular machine shown in Figs. 1 and 2, it would be preposterous to suppose that the style of the reproducer could track the spiral groove on the tablet F, if the mechanical feed screw, 5, were omitted, consequently it is evident that the real invention sought to be disclosed in the patent, is the minute automatic adjustment of the reproducer head and its style as an additional feature in the otherwise complete organized machine of the Edison type having a mechanical feed.

That this understanding of the invention is the proper and reasonable one, I believe to be the case, and, in this, I am sustained by Mr. Tainter himself in his deposition in the Leeds case, wherein he says, in answer to Q. 7:

"A. The difficulty of tracking the groove increases as its width and depth diminishes.

"With record grooves equal in size and in shape, the reproducer will follow a pitch of ten to the inch as readily as it will one of one hundredth; but should the

reproducer, for any reason, leave the groove, it might, in the case of the coarse pitch travel along on the surface of the record cylinder between the grooves, while, with the fine pitch, the space between the grooves being too narrow to support the reproducer the motion of the cylinder throws it to the one side or the other and into the groove. If, in the case of the coarse pitch, the groove is made equal to the pitch, the tracking will be less difficult than in the case of the finer pitch, as there is no place for the reproducer to rest outside of the groove, and when the groove is large it is most effective in guiding the reproducer. A disturbance that would throw the reproducer out of a fine groove would not interfere with the tracking of a large one. (pp. 190-191.)

And, supplementing that statement, in a further question, namely, $\times Q. 24$, Mr Tainter states:

"A. What I mean by this statement is that with what we call a fine pitched record the dividing ridge between any two grooves is nearly if not quite sharp at the top. While it would be possible perhaps to make the reproducer rest upon this ridge while the record surface is stationary, the moment the recording surface is put in motion, the reproducer will be thrown off to one side or the other and into the groove." (pp. 198-199.)

This agrees fully with the explanations of the action and function of the universal joint mounting of the reproducer. It is quite clear that the style, in seeking the bottom of the groove, must be automatically guided in its lateral movement by one of the slight sloping walls of such groove. And it is not until the style reaches the bottom of the groove that the effectiveness of the vertically undulating record therein becomes apparent. The side walls are merely guides and help to maintain the style upon the operative portion of the record in the bottom of the groove.

This invention, therefore, obviates all necessity for fine hand adjustments of the style to the groove, and makes the apparatus automatic, so far as adjustments are concerned; but this provision for automatic adjustment within the pervue of a groove, does not contemplate in any manner dispensing with

the mechanical feed to bring the successive portions of the groove transversely under the style; by that I mean, the recitilinear feeding of the record as this is an essential part of the apparatus disclosed in the Bell and Tainter patent, wherever the universally supported reproducer head is employed.

Now it is evident that if the style is to move in the manner above pointed out, both by the patent and by Mr. Tainter, one of the inventors of the graphophone claimed, such style must be narrower than the record groove, since, otherwise, it could not be moved laterally within the same, over the sloping wall down to the bottom. While Mr. Cameron seems to have some doubt upon this point, I have not. The patent itself says very little about it. It states that the reproducing style shown in Figs. 7 and 10, is:

"formed of a narrow metal strip bent near the end as shown in Fig. 8, and pointed as shown in Fig. 7,"

and the drawing certainly shows it smaller than the recording style. But as the scales of these drawings are not stated, we must rely more upon the statement in the specification that as the style must be free to move laterally within the groove to adjust itself, it must certainly be narrower than the said groove and consequently narrower than the style which produced it. There can be no doubt on this point in my judgment, and, in this conclusion, I am sustained from the fact that Mr. Tainter, in his Patent No. 341,288 of 1886, also here in suit, when referring to the reproducing style says:

"The outer end of this style (which should be somewhat more tapering at the point than the recording style) rubs over the record or tablet." (p. 6, lines 72-75.)

And in describing the function of that style, in connection with the grooves, he states, on page 8, lines 83-93 of said patent, as follows:

"It is then released, and the reproducer falling forward, brings the style into contact with the record.

Preferably the grooves are so close together that the ridge between them tapers to an edge on top, so that no matter where the reproducer may be placed, the style will enter a groove, and being free to move sidewise, will, owing to the sloping sides of the groove, penetrate to the bottom thereof under the action of gravity."

As both the patents 341,214 and 341,288 were issued on the same day, it can only be assumed that the same method of operation and construction regarding this feature of the reproducer style, was the same in both cases.

"Defendants' Exhibit No. 25" before referred to, showed that the diameter of the commercial recording style of the gramophone was almost exactly five one hundredths ($\frac{5}{100}$) of an inch, and "Defendants' Exhibit No. 27," which is a micro-photograph of one of the commercial reproducing styles of the graphophone, made on the same plan and scale as "Exhibit No. 25" shows that this reproducing style is almost exactly four one-hundredths ($\frac{4}{100}$) of an inch. The point of the reproducer is spherical, and, if it is inserted in the curved record groove made by the cylindrical style of "Exhibit No. 25," it will touch that groove at one point only; and the point which it is intended to touch is the middle point at the bottom of the groove, or because of reasons already explained, when referring to "Exhibit No. 26," the said point of contact to be somewhere close to the middle point, that is to say, at some point between the dotted lines marked on said exhibit.

In connection with the machine illustrated in Figs. 1 to 11, and also the machine illustrated in Fig. 13, the patent shows the reproducer style so mounted that it extends diametrically over the face of the reproducer diaphragm, and projects with its point beyond the edge of the reproducer head, and is, at that end, curved downwardly, so that it may bear with its point upon the bottom of the record groove, the diaphragm of the reproducer being approximately parallel to the plane of the record surface. For some unaccountable

reason, Messrs. Bell and Tainter assumed this projection of the style point to constitute an invention. They say :

"The invention consists, sixthly, in a reproducer or reproducing-instrument in which the reproducing-style, instead of being placed behind the support, projects at the point beyond the edge thereof. One practical advantage of this is that it enables the position of the style on the record or phonogram readily to be observed" (p. 2, lines 14-21).

Bell and Tainter do not state of what use it would be to observe the position of the style on the record. The record is so exceedingly fine that it is practically impossible to distinguish one groove from the other with the unaided eye, and, therefore, any special observation of the style in the groove would be useless. In the practical graphophone, such as is found on the market, and made under this Bell and Tainter patent, the style of the producer does not project beyond the head, and can, therefore, not be seen ; and so far as I am aware, no inconvenience arises from this. While there appears to be no utility in projecting the style so that it can be seen in contact with the record groove, it is a most expedient, in any piece of mechanism, to extend any portion thereof beyond an obstruction or shielding portion where observation of the part is desired, and such extension would certainly not involve invention merely because of such extension. In my opinion, there is no invention in this extension. However, long prior to the date of filing the Bell and Tainter patent, reproducer styles were mounted so as to project far beyond the edge of the reproducer head, and so that their contact with the record tablet could be observed if so desired. For example, such a construction is shown in the patent to A. W. Hall, "Defendants' Exhibit, No. 5," to which I have before referred in connection with this feature. I would point out that while Hall shows what he calls a "duplex or divided record," and therefore in such apparatus needs two reproducing styles for effective reproduction, he says, in his specification, on page 3 :

"Although the greatest advantages resulting from the use of a lever between the diaphragm and recording surface are obtained by the use of two points giving a duplex or divided record, the advantage of leverage between the diaphragm and the recording-point would be considerable with a single point, giving a single undivided record."

This shows that Mr. Hall would use a single style mounted so as to be far beyond the edge of the reproducer, if he used a single undivided record such as employed in the Bell and Tainter patent. Mr. Hall evidently did not think that the placing of his reproducer style beyond the edge of the reproducer head of itself constituted an invention, and I agree with that view, as I can see no invention in this suggestion. Aside from the Hall patent, showing this construction, it is also very clearly shown in the phonoautograph at the Boston Institute of Technology, and clearly disclosed in "Defendants' Exhibit No. 34." Projecting styles which could be seen and observed are also to be found in the prior Edison patents. For example, it is shown in substance in Fig. 8 of Edison's English Patent No. 2909, of 1877, "Defendants' Exhibit, No. 32," Fig. 27, and substantially in Fig. 18 of Edison's English Patent 1644, of 1878, "Defendants' Exhibit, No. 11," and likewise, substantially in Fig. 5 of Edison's American Patent No. 227,679, of 1880, "Defendants' Exhibit, No. 6." I would point out that in both the constructions of Figs. 18 of the English Patent 1644, and Fig. 5 of the American Patent No. 227,679, the recording style is approximately at the periphery of the reproducer head, and can readily and clearly be observed. While they do not project beyond the metal of this head, they nevertheless have the style points beyond the diaphragm and the mass of the head so they are not obstructed from view, and so far as the substance of this alleged improvement in the Bell and Tainter patent (more specifically set out in Claim 25) is considered, it is fully anticipated by these Edison constructions last mentioned, as well as the previous ones.

In addition to the machine illustrated in Figs. 1 to 11, of the Bell and Tainter patent in suit, there are also illustrated two other types of machines. One such machine is illustrated in Figs. 12 to 17, and which I will call the second machine. This second machine has in common with the first machine, that the record is engraved spirally into the face of the circular flat tablet, which is moved laterally at the same time that it is rotated. It is not moved laterally in a straight line, as in the first machine, but is carried by a swinging arm, L, pivoted at 51 and 52. Here, again, the reproducer style is held comparatively fixed, with reference to the lateral movements of the tablet, but is also provided, adjacent to the reproducer head, with the universal joint in the shape of a short section of soft rubber tubing, to enable the slight lateral automatic adjustment of the style to the bottom of the groove. In this particular machine, in place of the reproducer head being substituted for the recorder head on the same pivoted arm, it is made as a distinct, complete, structure, so that the machine is provided both with a complete recorder and complete reproducer, substantially as was the case with the Edison patent, "Defendants' Exhibit, No. 3," and the Edison English Patent No. 2909, of 1877, Fig. 29, and Edison English Patent No. 1644, of 1878, Fig. No. 27.

The third machine illustrated in this Bell and Tainter, patent, as shown in Figs. 18 to 20, and comprises a paper strip coated with wax upon which the record is engraved, the said strip winding from one reel around a guide wheel on to another reel, and in passing around the guide wheel, being caused by a record groove to act upon the style of a suitable reproducer head. For reproduction the reproducing head is clamped in position, in a rigid manner, after having been adjusted by hand, to make the style engage the record groove, so as to bear upon the elevations and depressions at the bottom thereof. The style is mounted upon a *thin rubber diaphragm* and as shown in Fig. 20, projects approximately in line with the centre of the diaphragm being attached to one side thereof. The flexibility of this diaphragm allows

the style to have an exceedingly small, free, movement in all directions, and would possibly allow the style enough free movement to follow the bottom of the record groove, but whether this would be sufficient to compensate for any material irregularities therein, I am not prepared to say. It is doubtful whether it would secure any more free, universal movements than is allowed in the Edison reproducer style constructed as shown in his American Patent No. 200,521, "Exhibit, No. 3," and certainly would not allow as much freedom of movement as would be had by the style of the reproducer shown in Fig. 27, of the Edison English Patent, No. 1644, or of the construction shown in Fig. 8 in English Edison Patent, No. 2909. I would also call attention to Fig. 22 of Edison's English Patent No. 1644 (and to which I have previously referred in speaking of the prior art), because, in this figure we have the reproducing style directly connected to the diaphragm at a distance from its centre and the point of the style arranged in line with the centre, almost identically corresponding to the construction shown in Fig. 20 of the Bell and Tainter patent in suit. The flexibility of this style, especially when the diaphragm is made of parchment or rubber, as contemplated in these early English patents of Edison's, would be very great and would permit all of the lateral adjustments, or universal adjustments, which is contemplated for the style of Fig. 20, and included for example, under claim 19.

From what I have stated it is evident that I am of the opinion that the structure of phonograph disclosed in the Bell and Tainter Patent No. 347,214, in suit, is, in all material respects, an embodiment of the essential characteristics of the Edison English Patent No. 1644, "Defendants' Exhibit, No. 11," and that whatever novelty, if any exists over what is shown and set out in the Edison patent, must reside in the adaption of a universal joint, or at least a joint permitting lateral motion, to a slight degree, located immediately at the reproducer head, and connecting it with an arm, which is otherwise pivoted in the well known manner shown in the

Edison prior patents, with capacity for swinging to and from the record surface, and acting by gravity to automatically follow the surface of the record tablet in a direction vertically to the surface thereof. That Bell and Tainter have largely copied the details disclosed in the Edison patent, it is very apparent, upon careful comparison, and I will briefly point out in how many particulars they have copied Edison's apparatus.

Adjourned until Friday, Feb. 15, 1901, at 11 A. M.

PHILADELPHIA, Feb. 15, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of witness, R. M. HUNTER, resumed.

(Mr. Hunter continues his answer to Q. 7.)

Considering first the machine illustrated in Figs. 1 to 11, on sheet 1 of the Bell and Tainter Patent, and comparing it with the Edison English Patent, 1644, and more particularly with Figs. 1 and 2 thereof, we see that in both machines there is a revolving turntable or disc driven by mechanical means, namely, in the Edison Patent by clockwork, and in the Bell and Tainter Patent by a fly wheel crank and friction driving pinion. In both the turntable carries a circular record tablet, and which tablet is identical, that is to say it is a tablet of cardboard coated with a wax compound, and in which a spiral record groove, having vertically undulating record variations at the bottom and sloping walls. While Fig. 1 of the Edison Patent is more particularly described with respect to the tin foil tablet, nevertheless the patent is very clear in its statement that it may be formed "of paper or other material * * * coated with paraffine or other hydro-carbons, waxes, gums or lacs, and the sheet so prepared * * * itself be indented." (Page 7, line 26-28).

As I have before pointed out, in both the reproducer is provided with a delicate style and has the reproducer head carried on the free end of an arm pivoted on a transverse

axis beyond the periphery of the turntable and parallel to the surface of the record tablet, so that it may float or ride upon the surface under the action of gravity. In both there is a *positive mechanical feed* to produce a transverse relative movement between the record tablet and the reproducer, the said feed being independent of the floating character of the arm supporting the reproducer, the construction being such that the reproducer has free movement at right angles to the surface of the record tablet independently of the positive transverse relative feeding of the record to the reproducer to bring successive grooves of the record, or rather successive spirals of the same groove, into mechanically operative position with the style of the reproducer. As I have before pointed out, in the Edison machine, Figs 1 and 2, the reproducer is mechanically fed transversely over the record, from groove to groove, whereas, in the machine of Figs. 1 and 2 of the Bell and Tainter Patent, the record is fed transversely past the reproducer head, but this difference is wholly immaterial and was fully recognized by Mr. Edison, who, in showing different types of his invention, illustrated and described various modifications showing that the tablet may be mechanically fed, as in Figs. 1, 2, 13 and 15 or the reproducer may be fed over the tablet as illustrated in Figs. 12, 15 and 36, for example. Likewise, in his American patent, Exhibit, No. 6, Mr. Edison shows in Fig. 1, the feeding of the tablet past a relatively stationary reproducer, and in Figs. 3 and 4 of the same patent he shows a reproducer mechanically fed over the record, thereby establishing, beyond a question, that the two methods of securing the relative feed between the tablet and reproducer, were well-known equivalents at the date of the Bell and Tainter patent. In the Bell and Tainter feed, a screw and stationary nut is employed, as the means of moving the tablet support, or turntable, and likewise, a screw and stationary nut is the feeding means for the tablet support in Mr. Edison's machine when he makes the relative movement by moving the tablet, so that the same details have been employed in both the Edison

machines of the prior art, and the Bell and Tainter machine of Figs. 1, 2 and 3 of the patent in suit. Every material feature of this machine is fully disclosed in the Edison patents with the exception of the additional small piece of rubber tubing constituting the additional universal joint adjacent to the reproducer head, and between it and the arm supporting it, which arm is pivoted at its other end, upon an axis parallel to the surface of the record tablet. The pivoting of this arm is so clearly shown in the Edison English patent, 1644, "Defendants' Exhibit, No. 11," and in Figs 3 and 4 of his American patent, 227, 679, "Defendants' Exhibit, No. 6," that it is unnecessary to make more specific reference to this feature, since I have before pointed it out, at considerable length, in my previous answer. As before stated, the arrangement of the reproducer head parallel with the surface of the spiral record, is also shown in the Edison patent, and, furthermore, the employment of a reproducing style, arranged out of line with the centre of the diaphragm, and adapted to project to a position adjacent to the periphery of the reproducer, so that its position upon the record may be seen, is also clearly shown in substance in Fig. 18 of the English patent, 1644, and Fig. 5, of the American patent, 227,679 of Mr. Edison. In this connection, I would also refer to Fig. 27, of Edison's English patent, as it clearly shows the reproducer point on the record that it can readily be seen and thereby accomplish all of the imaginary advantages of the Bell and Tainter style; and while speaking of this figure 27, I would again call attention to the fact that it shows the style so mounted as to have every possibility of lateral and vertical adjustment, such as would adapt it to readily find the bottom of any groove in which it might be brought into contact with, thereby disclosing the essence of the Bell and Tainter machine, Figs. 1 to 11, so far as claims 19, 20, 22 and 25 of the Bell and Tainter patent in suit are concerned. The essence of the Bell and Tainter machine is, therefore, taken from the Edison prior invention.

Having thus shown that Bell and Tainter have merely

copied the Edison inventions in the first machine illustrated by them, I will now show that even the second machine illustrated by them in Figs. 12 to 14, has also been copied from this Edison English Patent 1644. The general statement which I have made with regard to the first machine in connection with the fact that Bell and Tainter feed their record transversely under the relatively stationary reproducer, while Edison shows both that idea and the reverse, also holds good in connection with the second machine. The gearing, however, for causing the relative transverse feeding, between the record and reproducer is absolutely identical in the two patents. Every essential feature of this feed found in the parts D 56, 57, 58, 59, 50 and 53 of the Bell and Tainter patent, are also found in Fig. 8 of the Edison patent, and in the description describing said Fig. 8, and to which I have before referred in my previous answer, the said Fig. 8 showing a modified type of feed, as a substitute for the particular type of feed shown in Figs. 1 and 2. In the Edison case, the gearing produces a swinging motion to the reproducer arm i, and, consequently, to the reproducer itself, whereas, in the Bell and Tainter patent, the same gearing produces a transverse feeding of the record. The reason of this is that, in the Bell and Tainter structure, the fulcrum or pivot of the reproducer arm, and its supporting frame B, are held stationary and the tablet supporting frame is permitted to move, whereas, in the Edison illustration, the tablet supporting frame is held stationary and, consequently, the pivoted arm of the reproducer, and its support, or fulcrum, is caused to move. It is simply a case of which part you choose to hold stationary, and nothing more. It thus appears that in the second construction of machine shown in the Bell and Tainter patent, they have again had resort to the Edison English Patent No. 1644 to obtain the essential features of their apparatus. The only thing of any moment which they show in this second machine, not specifically shown in the Edison patent, is the little piece of rubber tubing 32, for directly supporting the reproducer head upon the free end of the old pivoted arm.

Referring now to the third and last construction of machines shown in the Bell and Tainter patent, I find that they have once more had resort to the Edison English Patent 1644, and, more particularly, to the modification shown therein in Fig. 5. It is interesting to notice how minutely they have copied Edison's constructions. In the Machine of Bell and Tainter and that of Edison, we have the following similarities. In both, a strip of waxed paper is provided with a vertical undulating record groove and is wound from one reel on to another by a crank mechanism, and in its passage from one reel to the other, it is guided about a positively driven guide wheel. In both there is a fixed reproducer head having a very flexible style arranged adjacent to the centre of the diaphragm, and operating in the record groove of the strip tablet as it is fed under the said reproducer head. In both the reproducer is shown with a style directly connected to the diaphragm, and having its point in line with the centre of the diaphragm. (See Fig. 20, Bell and Tainter patent, and Fig. 22 of Edison's patent.) Regarding the possibility of lateral flexibility of the reproducer style, in a construction like this where the reproducer head is fixed, I have already shown at great length that the Edison constructions using light and delicate diaphragms of parchment or rubber, as stated in the Edison English patents, would give every possible freedom of lateral adjustment that could be implied as being required in the Bell and Tainter structure, and I have no doubt in my mind for a moment but that the flexibility of the style of Fig. 27 of the Edison patent, is far greater in capacity respecting the lateral adjustment than would be the case with the particular construction shown in Fig. 20 of the Bell and Tainter patent. Even the means for adjusting the reproducer head to and from the record strip, or tablet, is fully shown in the Edison patent referred to and it is certainly shown also in American patents to Edison, "Defendants' Exhibits Nos. 3 and 6."

The Bell and Tainter structures, therefore, have all been taken in substance from Edison's English Patent, No. 1644,

with the single exception of the specific feature of the middle piece of rubber tubing, for directly supporting the reproducer head on the old, floating reproducer arm, and this is, in my judgment, the extent of their improvement over the disclosures of the prior art, and while, as a mechanical construction it was an addition or adjunct to the positive, mechanical feed machine of Edison, I am not prepared to say that it was an invention, for reasons that I have already stated, namely, that the vertical adjustment of the reproducer head at right angles to the surface of the tablet was accomplished by the old pivoted reproducer supporting arm of Edison, acting by gravity, and, therefore, there was no necessity of providing an additional universal movement in that direction, in a machine of the character shown in the Bell and Tainter patent; and, secondly, because the capacity for lateral adjustment of the style to seek the bottom of the groove brought into its proximity by the mechanical feed, I have shown to be substantially disclosed by the Edison English Patent, and, therefore, the mere locating of the said universal joint specifically so as to immediately support the reproducer head (Claim 21 and 23), as distinguished from supporting the style, which is really the thing acted upon, is wholly immaterial. This question, however, is one for the Court to determine with the full facts before it, and in any event, the only novelty in actual construction, which I perceive in the Bell and Tainter machine, over the prior art, is in locating this small section of soft rubber tubing immediately between the reproducer head and the free end of the old pivoted arm, and to be used as a universal joint of exceedingly small required adjustable capacity in connection with a positive mechanical feed for producing a relative, regular, and extensive feeding action between the record tablet, and the reproducer head.

Recess.

Q. 8. Is there, in your opinion, more or less liability of lost motion in the mechanical feeding devices in the Bell and Tainter patent in suit, as compared with the types of the Edi-

son machine shown, for example, in Figs. 1, 2, 13, 14 and 15 in his English patent, and also shown in his American Patents, No. 200,521, of 1878, and 227,690, of 1880, and what relation would an increase in the lost motion have on the registry of the style and groove of the tablet.

A. There is more lost motion in the Bell and Tainter feeding mechanism than that in the Edison machines. In the Edison machines, the screw or feeding spiral is an integral part of the cylinder or table upon which the record tablet is clamped, and there is, therefore, the least possibility of lost motion affecting the registry between the reproducing style and the record groove, and, therefore, where the record grooves were of a size that could be readily seen, there was little trouble from that of adjustment, especially where the style was flexibly supported and made sensitive, as so frequently suggested and advised in said Edison patent. In the construction of the Bell and Tainter machines, Figs. 1 to 14, there was a complicated indirect method of feeding the tablet record relatively to the reproducer. In Figs. 1, 2, and 3, it is seen that this gearing consists of the turntable shaft carried in one journal and geared by miter gear 4, with a screw 5. This screw works in a solid nut, 6, and it is also journaled on a frame C, which moves as a slide on a guide on frame B. It is thus seen that there are numerous places for possible lost motion, and said lost motion would undoubtedly be greatly in excess of that in the Edison machines, and this lost motion would be constantly made worse in the operation of the machine by the nature of the means employed for driving the turntable, since it locates the strains upon the bearings in an objectionable manner. By reason of the variability of the relation between the feed and record, thus objectionably introduced by Messrs. Bell and Tainter, the utility of automatic adjustment of the reproducing style to the bottom of the record groove, even in the small capacity of one-one-hundredth ($\frac{1}{100}$) of an inch, is far greater in their machine than it would be in the Edison machine, and for this reason Bell and Tainter introduced the little tube of

soft rubber immediately at the head of the reproducer to overcome this objectionable lost motion, which they introduced into their machine, as well as to compensate for the irregularity in the position of the groove where the records have been changed, as I have before pointed out.

Q. 9. Please consider Letters Patent No. 341,288 to Tainter, here in suit, in so far as the subject matter of Claim 44 is concerned, and Letters Patent No. 375,579 to Tainter, here in suit, in so far as subject matter of Claim 20 is concerned, and state the relation which these patents bear to the prior state of the art.

A. The Tainter Patent, No. 341,288, describes improvements or modifications of what is shown in the Bell and Tainter patent before considered. The patent states, on page 9, lines 91-98 :

"The present invention is to be considered as an improvement upon or modification of what is shown and described in the application for letters patent of C. A. Bell and myself, filed June 27, 1885, and officially number 170,044, so far as they relate to common features, and no claim is made herein to any matter described and shown in that application."

The specification contains a re-statement of the invention set forth in patent 341,214 more clearly than in the original patent itself. The machine described is much improved over the first one, and was probably the type of machine that first came into public use under Bell and Tainter's directions. As we are only to deal with Claim 44, of this patent, I will simply refer to those portions of the specification referring to its subject matter. On page 3, lines 55-80, the patent states: the nineteenth improvement which is the one we are concerned in, as follows :

"Nineteenth. In transmitting the vibrations to the diaphragm it is found that the rigid connections between the record and the diaphragm pronounced foreign vibrations are impressed upon the diaphragm or its substitute, producing scratching noises. These foreign noises can

be lessened without diminishing the reproduced speech to the same extent by the interposition of a flat metal spring in such a way that while serving as the means of communicating vibrations to the diaphragm it can be bent independently. It is probable that this spring absorbs the vibrations which produce the scratching noises to the greatest extent, because they are more minute and rapid than speech vibrations. Hertofores a section of rubber tubing has been interposed between the style and diaphragm; but it cannot be made as delicate as a metal spring, and for other reasons, also, it is not so advantageous. It is believed that it does not transmit the true vibrations of the record with as much clearness, the rubber loses its elasticity after a short time, and the tubular form of spring is less compact and less easily secured in place."

The above description is a general reference to the several figures of the drawings showing reproducing styles and their connections, but it is not specifically drawn to either one of these particular illustrations, there being a number of modifications shown. The above language is supplemented by further statements on page 6, lines 66-103, and again in matter which extends from line 113, page 7, to line 17, page 8. The constructions are shown in Figs. 4, 11, 13, 15 and 17. However, the language of the claim, 44, to which my attention is directed, must, in a measure, govern which of these constructions are the ones to be considered in connection with said claim. The claim reads:

"44. The combination, with the reproducer-style and the diaphragm or device upon which the reproduced sonorous vibrations are to be impressed by said style, of a flat metal spring interposed between the style and diaphragm and forming a yielding connection through which the reproduced vibrations are transmitted, said spring having a practically rigid connection with the diaphragm, substantially as described."

This claim requires that the flat metal spring shall form a yielding connection between the style and diaphragm, and this condition is satisfied by the constructions shown in Figs.

11, 12 and 15, as I understand the testimony of Mr. Cameron, the complainants' expert. With regard to this, Mr. Cameron states: in answer to Q. 7:

A. "The reproducer defined in Claim 44 of the patent mentioned is best shown in Figs. 12 and 15 of Sheet 5 of the drawings, the latter figure afforded a very clear illustration of the construction defined by the claim.

Rigidly secured to one end of the frame or head of the reproducer is a flat spring 359, this spring has a style, 382, of Fig. 15, secured to it on one side, while the other side of the spring is in connection with the diaphragm, 362, through the metal button 284. As the point of the style is vibrated by the undulations of the sound groove, the spring 359, by its bending in and out, transmits the vibration through the rigid connections 384 to the diaphragm, the spring serving as a sort of elastic hinge to unite the style to the frame and the button serving as the transmitting medium between the spring and diaphragm."

And after referring to the claim 44 of the patent, Mr. Cameron further says:

"For the reasons given I understand the terms of this claim are clearly intended to include any form of reproducer which has a spring upon which the reproducing style is supported, and which spring has rigid connection between it and the diaphragm * * *"

Accepting the above statements of Mr. Cameron as being the intent and purpose of the language of Claim 44, we see that he considers the claim of such scope as to include any mounting for a reproducer style in which there is a flat metal spring interposed between the diaphragm and record tablet, connected on one side to the reproducing style, and on the other side, with the diaphragm, by "a practically rigid connection." Assuming that Mr. Cameron's understanding of the meaning of Claim 44 is correct, and that the "practically rigid connection" may be a small block of cork as at 363 in Fig. 12, or a small button as at 483, in Fig. 15, the only apparent alleged novelty in this construction is in using

the said "practically rigid" connection as distinguished from the tubular rubber connection of the Edison reproducer referred to in the 19th statement of invention above quoted. As I view this matter, it seems to me that such a difference does not involve the exercise of the inventive faculties in its production, and, therefore, lacks invention. But, assuming that this difference is worthy of consideration, as embodying a possible novelty, I find upon comparing it with the prior art, that it is fully anticipated for the following reasons. In Edison's American Patent, No. 200,521 (Exhibit, No. 3) I find a reproducer C, having its diaphragm connected by a thread, or other substance capable of conveying the movements to the diaphragm, with a flat spring of delicate construction, extending parallel with the diaphragm; and this spring carries at its free end the reproducing style. Here we have the style connected with the flat spring, and the flat spring connected in turn by an additional device or part. Referring to this connection, the patent states:

"This spring is connected to the diaphragm F of C by a thread or other substance capable of conveying the movements of D."

Here we have a style, a flat spring interposed between the style and the diaphragm and forming a yielding connection between the two, just as called for by Claim 44 of Patent No. 341,288, in suit. But the spring in this case is not described as rigidly or practically rigidly connected with the diaphragm, but, as the "other substance" of the above quotation as a substitute for a thread might be almost anything, rigid or otherwise, a construction under that statement may very readily employ the "practically rigid connection" of Claim 44, and that this was understood by Mr. Edison is seen from the further language of the patent which continues:

"Now, when the cylinder is allowed to rotate, the spring D is set in motion by each indentation corresponding to its depth and length. This motion is conveyed to the diaphragm either by vibrations through a thread or *directly by connecting the spring to the diaphragm* F. * * *"

This means that the thread between the spring and diaphragm may be dispensed with and a direct, positive connection made between the diaphragm and spring, and such would form the "practically rigid connection" called for by Claim 44.

I would also refer to the illustrated article in "Nature," "Defendants' Exhibit, No. 20," and to which I have referred in considering the prior art. In this article is shown a reproducing diaphragm and style. The style in this case is at the end of a flat spring extending parallel to the diaphragm, and this spring is connected on the side opposite from the style with the centre of the diaphragm by a small rod or piece of wood. It is true that minute rubber pads are supposed to be arranged at each end of the wood rod but this at most is to prevent undesirable sounds from the connections, and does not in any wise introduce an elasticity, but leaves the connection between the flat spring and the diaphragm as a "practically rigid connection" such as called for by Claim 44 of the Tainter Patent No. 341,288, in suit. In this connection, I would direct attention to the fact that the small block, 363, forming the "practically rigid connection" in the Tainter patent, is of cork, and, consequently, it would have fully as much, if not more, elasticity than the small pads mentioned in this article in "Nature."

I would also refer to "Defendants' Exhibit, No. 15" and particularly to that part thereof referring to the reproducer, which reads:

"A metal point, if the tracing is in grooves (or notched finger if it is in relief), is held by a spring on this tracing and at the other end of the finger which supports this point is solid with the centre of the surface of the suitable membrane for producing the sounds."

This, I understand, clearly describes any possible alleged novelty in Claim 44, under the understanding of Complainants' Expert, because in the Cros's device, the flat spring was interposed between the style and the diaphragm, and was connected to the diaphragm by a "solid" connection,

and, therefore, one which is rigid. I have referred to this when considering the prior art.

Adjourned until Monday, Feb. 18, 1901, at 11 A. M.

PHILADELPHIA, February 18, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of witness, R. M. HUNTER, resumed.

(Mr. Hunter continues his answer to Q. 8)

I am also of the opinion that Claim 44, under the terms applied to it by Mr. Cameron, would also be clearly anticipated by Edison's English Patent No. 2909, of 1877 ("Defendants' Exhibit, No. 32"), as shown for example the constructions illustrated in Fig. 5 and 29, in which a spring is rigidly supported at one end which acts as a fulcrum, and at its free end, is divided on one side with a style, and its other side it is connected with a "straw" which unites it to the diaphragm. This straw acts as a practically rigid connection between the spring and the diaphragm.

The construction is also fully anticipated by the phonograph shown in "Defendants' Exhibit, 34" and which is in the possession of the Boston Institute of Technology. As I have before pointed out this apparatus comprised a very flexible diaphragm connected by a small piece of wood with the middle portion of a long, light flexible style carrying bar, or arm, the free end of which is provided with the style. This exhibit describes that the style is made very slender and light, either of a piece of deal or a straw. It is attached at one end to the frame of the diaphragm, and is connected with the diaphragm by a short piece of "broom-corn," which is glued both to the flexible lever and to the diaphragm, and forms a "practically rigid" connection, and carries upon its end beyond the diaphragm a style consisting of a stiff bristle. A long straw has considerable flexibility and may be considered in the sense of a spring, so far as elasticity is concerned if the said device were used as a reproducer. The elements, there-

fore, of Claim 44 are substantially found in this old phonautograph, and this answers the statements regarding Claim 44 by the complainant's expert, Mr. Cameron, in which he says the invention of this claim :

"may be applied to a reproducer having the style point projecting beyond the edge of the frame after the manner shown in Figs. 7 and 9 of the Bell and Tainter Patent in suit, and that a style so projecting may be used in connection with * * * a zig-zag or laterally undulating sound groove * * *"

And further, he asserts that the claim is not to be construed in a limited sense in view of the statement in the patent, lines 57-67, p. 9. Under such a view of Claim 44, it seems to me that the essence of the same is disclosed in this phonautograph, "Defendant's Exhibit 34," especially in view of the fact that any minor differences between what it actually shows and that of the constructions shown in the Tainter Patent 341,288, in suit, are fully disclosed in the other exhibits to which I have referred.

Referring now to the Tainter Patent, No. 375,579, I find that it is set out as an improvement upon the apparatus described in the Tainter Patent, No. 341,288, above considered. One of the improvements in this patent refers to the reproducing style, the same being made in the form of a bell-crank lever. The longer arm of the said lever carrying at its free end the style proper, and the short arm being connected with the diaphragm by a thread. This is clearly shown in Fig. V. The description of this construction is found on page 5, lines 57-97, and following this the specification states :

"One advantage of using a lever as the reproducing style is that by making the inner arm shorter than the outer, as shown in the drawings, the motion of the diaphragm can be reduced, which, though it involves a slight loss in loudness, is found to produce a more than compensating gain in distinctness of enunciation."

Another advantage which does not seem to have been specially mentioned is that by the employment of a specific

bell-crank for the lever style, the diaphragm need not be placed parallel to the surface of the record tablet, as is clearly illustrated in Fig. V. This advantage, however, would only result from the employment of a clearly defined bell-crank, and not from every kind of lever. It is therefore true that the advantage of a lever generally is that the motion of the reproducing diaphragm can be made smaller than the motion of the style point.

I find that this idea was clearly shown in the prior art, for example, it is expressed quite fully in the Edison Patent No. 227,679, of May 18, 1880, "Defendants' Exhibit, No. 6." In Figs. 5 and 6 of that patent there are shown recording and reproducing diaphragms and styles, and the styles are, in both cases, formed on or mounted on levers. In Fig. 5, the style is on the free end of the lever, and the diaphragm is connected with the lever at a point intermediate between its pivot and the free end. In this construction, when it is used as a reproducer, the amplitude of vibrations of the diaphragm would be smaller than those of the style.

In Fig. 6 the diaphragm is connected with what might be called the free end of the lever, and the style is midway between the two ends of the lever. Consequently, with the construction, if it is used as a reproducer, the amplitudes of vibration of the diaphragm will be greater than those of the style. Mr. Edison evidently believed, when he filed his application on March 29, 1879, that he was the first inventor of the reducing or magnifying lever in connection with phonographs.

He says, in paragraph extending from page 1, line 90, to page 2, line 7:

"Another feature of invention relates to a lever between the diaphragm and the phonogram, whereby the relative movements of the parts may be varied. This lever, 2, has a fulcrum at 15, if the connection to the diaphragm is between the point d and the fulcrum 15, as in Fig. 5, then the motion of the point will be greater than the diaphragm, and, when used in the phonograph, will amplify the indentations in the coil. If

used in the phonet the movement of the diaphragm would be lessened. I therefore prefer in that instrument to change the places of the point and diaphragm connection, as shown in Fig. 6, so as to amplify the movement of the diaphragm and increase the sound."

Mr. Edison also broadly claims the improvement as follows :

"4th : The combination, in a phonograph or phonet, of a diaphragm, a point, and a lever intervening between the lever and the point, substantially as set forth."

It is true that Mr. Edison does not show or describe a bell-crank lever having the end of one of its arms formed into a style ; nor does he describe a style and lever as being made in one piece, but while these features are described in Mr. Tajnter's specification, he claims his construction in much broader terms. For example, the following is his Claim 20 :

"20. The combination with the diaphragm of the reproducer, of the rubbing-style consisting of a lever having the rubbing point formed on one arm and the other connected with said diaphragm, substantially as described."

It will be seen that while this claim requires the rubbing style to consist of a lever having the rubbing point formed on one arm, namely : a lever and style formed in one piece, it is not restricted to a bell-crank lever. If this restriction were read into the claim, and the bell-crank feature were absolutely required, it would then call for a modification not specifically shown in the Edison patent ; but without this specific restriction, the Edison patent certainly shows and describes the lever and style as being formed in one piece and as a mathematical construction a long arm and short arm, one of which carries the style, and the other of which is connected to the diaphragm. The fact that Edison does not describe his style as being formed in one piece with the lever is of no moment as there is nothing to show that it is not in effect an integral part of the lever, and it certainly is rigidly attached to it if made separately in the process of construction. As I have before pointed out when considering the prior art that

while Claim 20 speaks of the lever as having two arms, it was not essential that said arms should lie in different directions, so far as Claim 20 is concerned, and, for this reason, the restriction to a belt crank, not being in the claim, the lever is fully disclosed in the Edison patent with the understanding that the long and short arms project in the same direction.

On the same reasoning, the phonautograph disclosed in "Defendants Exhibit, 34" also shows a construction of lever carrying on the long arm the style, and having the short arm connected with the diaphragm, somewhat similarly to Fig. 5 of Edison's patent, 227,679, and this phonautograph in my opinion anticipates any reasonable requirement as to the structure specified in Claim 20 of the complainant's patent.

Another patent of the prior art clearly disclosing the structure of the claim of the complainant's patent, is the U. S. patent, to Hall, No. 219,939, of 1879, "Defendants' Exhibit, No. 5." This patent showing, as I before pointed out when considering the prior art, the employment of a pivoted lever having two arms one arm being connected with the diaphragm, and the other arm carrying the style, the lengths of these arms are unequal and the pivot of the lever is intermediate between the style point and the diaphragm. This patent, therefore, shows a reproducer combined with a style, consisting of a lever having the rubbing or style point formed on one arm, and the other arm connected with the diaphragm of the reproducer, thus disclosing substantially the structure required by Claim 20 of the Tainter patent 375,579 in suit.

In view of these examples of the prior art, I am of the opinion that there is nothing of novelty set out in Claim 20 of complainant's patent.

Recess.

Q. 10. Are you familiar with the commercial gramophone as the same is represented by "Complainants' Exhibit, Defendants' Machine?" And are you generally familiar with the history and development of the gramophone?

A. I am familiar with the commercial gramophone, such, for example as exhibited in "Complainants' Exhibit,

Defendants' Machine" and think that I have a fairly full knowledge of the history relating to the development thereof. I have been familiar with the gramophone and its development, from the winter of 1887 and 1888.

Q. 11. Please state briefly some of the most important features in the development of the gramophone which raised it to a perfect machine from the early experimental stage.

A. Mr. Emile Berliner, in the year 1887, took up the matter of the development of an instrument for reproducing speech which he subsequently called "gramophone" with an especial view of utilizing a laterally undulating record such as produced on the phonautograph and as referred to in Cros's early French publications and patent before referred to by me when considering the prior art, in contradistinction to the types of machines developed by Edison, and subsequently modified by Bell and Tainter, employing the vertically undulating record. Mr. Berliner appreciated that in producing a record similar to that of the phonotograph a very small amount of work would have to be performed by the diaphragm, and consequently, the reproducing of the vibratory curves would be more accurate and perfect than in the cases of making a vertically undulating record. He also realizes that reproductions from this record should give more clear and better results than could be secured from the vertically undulating record. In the early work of Mr. Berliner, the phonographic record was produced on a metal plate in which the grooves were photo-engraved, the said grooves corresponding to the phonotographic record sheet previously produced. This experimental apparatus comprising the engraved record and reproducer having a diaphragm and style gave very imperfect results, although demonstrating at that time that louder articulation could be produced than with the vertically undulating grooves, if the record plate could be satisfactorily produced. One point which Mr. Berliner kept in mind was that as he employed a laterally undulating groove of even depth and in which the bottom of the groove was not relied

upon to produce the vibrations of the style, it was a matter of no consequence how the style was placed into the groove, that is to say, whether it rested heavily on the bottom or lightly, or whether it even came in contact with the bottom at all, since the actual operation of the record plate upon the style was by contact with the undulating side walls, first one side and then the other, that is to say, it required, as it were, two undulating records one forming one side wall, and the other forming the other side wall of the groove, and one of said side walls operating to move the diaphragm in one direction, and the other in the other direction, whereby the said diaphragm was put into positive vibration by mechanical means at all times. The general principle of this idea of Mr. Berliner's is clearly shown in his patent 372,786, dated November 8, 1877, the same being filed May 4, 1877. Mr. Berliner's first manner of producing a record was to make the phonograph record on a sheet of paper wrapped about a cylinder, and from which the photo engraved plate was made, but in 1877, he proposed to substitute for the paper a circular disc of glass to reduce the friction to a minimum, and to enable him to make a better photo engraving therefrom. Another improvement which he proposed at that time, and which he put into practice, was the employment of an improved ink or coating upon the glass in which the tracing was to be made, he having discovered that the lines traced upon a smoked surface such as employed in the phonograph revealed, when magnified, great unevenness and raggedness due to the character of the lampblack. This ragged appearance, under the magnifying glass, produced, in the photo engraving, similar irregularities which caused additional scratching sounds to be superimposed or impressed upon the articulate sounds desired. He desired to overcome this difficulty, and by experiment, produced a definite character of ink as a coating for the glass, composed largely of lampblack, with oil, to produce an amorphous ink, in which a very sharp tracing could be produced. His tracing upon the glass, had the record formed therein, as a spiral line

and the photo engraved record was also of similar character. At that time Mr. Berliner had a definite machine for producing the record in which the style, together with the reproducer head, was made to operate upon different portions of the surface of the disc by mechanically feeding the disc transversely across the style while the disc was being revolved, thereby producing the spiral record. He also evolved a reproducer which was caused to travel transversely across the record during its revolution by the propelling power of the groove acting upon the style of the reproducer. These constructions are shown very fully in Berliner's patent 564,586 of 1896, filed November 7, 1887, the same being marked: "Defendants' Exhibit No. 28." Fig. 10 of this patent very clearly shows the reproducer supported upon a movable carriage 55, and propelled by the action of the style 29, working in the laterally undulating grooves of even depth. This appears to be the first evidence in the phonographic machine of employing the record itself as the means for propelling the reproducer, and dispensing in a reproducing instrument of a positive, mechanical feed device, such as was necessary in the Edison and Bell and Tainter types of machines, and which has universally been employed in the commercial machines produced by Edison and the Gramophone Co. Berliner's reference to this automatic feeding is found in his patent 564,586, on page 4, second column, as follows:

"So, for instance, I can dispense with the centering device and can rotate the record upon a stationary axis, if the diaphragm with its attached style is mounted in a manner to make it follow the spiral record. An arrangement of this character is shown in Fig. 10. * * * The diaphragm casing, 31, is secured to a small truck, 55, upon rails, 56, arranged vertically above and parallel with a diameter of the reproducing disc, and at such height above the same that the stylus, 29, will be in engagement with the undulatory grooves of even depth which represent the record of sounds.

The listener applies his ear to the ear-piece and when the shaft, 6¹, is rotated, the stylus and diaphragm will be forced to vibrate, as in the apparatus shown in

Fig. 1, but will, at the same time, move with the truck, 55, across the face of the disc, 54."

In his early experiments, Berliner frequently tested the plate by allowing the plate to revolve while holding the reproducer head in his hand, and allowing the style to follow the groove, the arm thus acting substantially as the present arm acts in the modern gramophone to the free end of which arm the reproducer head is attached.

Mr. Berliner bent his energies to the perfection of the photo-engraved record, as he realized that the results to be secured depended very much upon the perfection of the record, rather than to the mere details of the mechanical parts of the gramophone, since he realized that the freely swinging arm hinge upon a universal joint and carrying at its free end the reproducer head was availed to him, as it was clearly illustrated in the Edison English Patent 1644, and also published in numerous publications, for example, in "Defendants' Exhibit, 21," He realized that there would be no difficulty in making his record mechanically feed the reproducer, and thus dispense with the troublesome mechanical feeds of the prior art, because he had demonstrated that he could produce a positive record groove of even depth which would have clearly defined side walls of great steepness, capable of retaining the style in position, and mechanically feeding the reproducer under the action of the style. He also realized that in his instrument the weight of the style of the reproducer head and arm was of very little importance, as that weight was taken up by the bottom of his groove, upon which there was no record. After consulting experts on photo-engraving and photo-lithographic processes, he developed a metallic record which he made by an etching process, the etching having been performed on a zinc plate through a line formed in a surface or film of bichromated albumen, the latter having been previously subjected to the action of light under a photographic reproduction of the record and washed. The plate was edged with diluted nitric acid, and thereby produced an etched plate having a laterally

undulating groove of even depth. He experienced difficulty however, with this process as the etching was not always uniform, and there were places in the plate where the style would not continuously track the groove, but was liable to jump up. This was important, because Mr. Berliner relied upon the groove as the means of causing his reproducer to be fed over the surface of the record plate, and it was very essential that he should have a clearly defined groove of even depth, and very steep side walls. Mr. Berliner realized that while he might have employed a mechanical feed to produce a rectilinear motion of his record plate, or to his reproducer, as had been done by others, too, in a measure, overcome the difficulties experienced in the etched plate, still, it was his object to dispense with any mechanical feed mechanism in the reproducer, or in the use of the machine in reproducing speech, because, as he maintained, it would be possible to greatly cheapen the cost of the machine if these mechanical feeding devices could be dispensed with, and he reasoned that if one portion of the etched plate was perfect it was within reasonable possibilities that the entire groove in every plate could be made perfect. He proceeded to follow out those ideas. He discovered that his difficulty was largely due to a presence of bubbles of gas, present in the grooves when the plate was in the etching bath, they interfering with the acting of the etching fluid.

In the early part of 1888 Mr. Berliner made some radical improvements, more particularly in dispensing with the indirect method of etching his records, and proceeded to develop the idea of making his tracing or records directly upon a prepared zinc plate, an etching directly through the tracing. This greatly simplified the process. He polished the surface of the zinc plate and coated it with a solution of wax, for example, beeswax and benzine. He secured in this manner an exceedingly thin and soft film upon the zinc plate. Through this film he traced a phonautographic record. The tracing was exceedingly fine and offered but little resistance to the diaphragm, consequently, the curves of the record

were perfect, The plate thus prepared was placed in a bath of diluted nitric acid, and, while he secured his etched record, it had some of the defects of the former etched record, due to the presence of the hydrogen gas bubbles, which interfered with the action of the nitric acid upon the plate. He then introduced chromate of soda into the nitric acid, the same acting as a depolarizer, and thereby getting rid of the bubbles very much as they are disposed of in an electric battery. The gas bubbles disappeared altogether, and while he got much better results, the wax covering for the rest of the plate was practically too thin to protect it, and the etchings frequently extended too far, frequently disfiguring the true groove. He next abandoned nitric acid and used chromic acid, properly diluted, with better results, and finally he secured his best result by the use of a mixture of sulphuric acid and bi-chromate of potash or soda, the latter being preferable. However, other difficulties appeared which frequently destroyed the clearness of the grooves and introduced other subsidiary grooves not desired. A great deal of investigation and experiment disclosed to him the fact that in making his tracing on the prepared plate small fibres suspended in the air would deposit upon the waxy film and being ragged along by the style, scratched the thin coating of wax sufficiently to reduce the wax at additional places in lines not desired, which subsequently enabled the etching fluid to work its way down to the zinc, thereby producing the undesirable features above pointed out. After considerable experiment with a view of overcoming this defect, he developed the idea of coating the plate and film with a layer of alcohol, while the record was being inscribed upon the plate. This idea disposed of the difficulty from the floating particles, but, in accomplishing this result, he introduced another, namely, the re-coating to a more or less extent different portions of the traced or inscribed record with an exceedingly thin coating of wax, which was due to the fact that the alcohol slightly dissolved portions of the wax coating, and subsequently, on evaporat-

ing, prior to the etching process, allowed this fine solution of wax to deposit upon the traced or inscribed record. This produced an irregularity in the etching process. Mr. Berliner immediately upon discovering this defect took the precaution of washing out all of the alcohol and any waxy or fatty constituents which it might hold in solution before the plate was removed from the recording machine. When this was done the etching was found to be perfect, the grooves were of uniform depth, the walls were sharp and steep and clean.

The more important of these stops which led up to the making of a perfect sound record are set forth in Berliner's patent before referred to, namely, 372,786, of 1887, "Defendants' Exhibit, 36;" in his patent 564,586, of 1896, "Defendants' Exhibit, No. 28" (application filed Nov. 7, 1887), and in his patent 534,543, Feb. 19, 1895, "Defendants' Exhibit, No. 9."

Mr. Cameron, testifying in behalf of the complainant, when considering the record plate, having in its surface a laterally undulatory groove of even depth, as employed by Mr. Berliner, endeavors to show that it was very old and well known before Berliner entered the field. He refers to the prior art which I have treated at considerable length, and especially to Cros's French Patent, of 1878, and also the paper deposited with the French Academy in 1877. It is quite evident that Cros never did any practical work, that is, he never reduced his invention to practice as far as evidence shows, and whether or not his suggestions were practical and could have been commercially carried out, is a matter which, it appears to me, is of little consequence in connection with the present case. That Berliner did enter the field and took up exclusively the idea of developing a record having laterally undulating characteristics, in a groove of uniform depth, and produced an inexpensive apparatus, which seems to me entitles his work to the fair consideration by the Court of his position in this art, and to entitle his work to a distinctive position relative to the work of Edison and Bell and Tainter, in view of the fact that the very essential features of their

work, embodied in all their commercial machines, is entirely foreign to the gramophone and *vice versa*. As I view the matter Edison and Cros were pioneers in suggestions; Cros was wedded to the laterally undulating groove, whereas Edison bent his efforts in the direction of the vertically undulating groove record. Edison followed up his suggestion by practical application thereof in a development of an effective phonograph. Bell and Tainter come into the field at a later date, and copied Edison's work, modifying his apparatus in certain minor particulars, but still adapting it to the essential features of a vertically undulating record with very shallow groove and gently sloping side walls, and this in connection with a positive, mechanical feed for producing the rectilinear motion of the record relatively to the reproducer, while reproducing the sound, the latter feature being clearly and definitely shown in their various patents, and embodied in their perfected apparatus known as the graphophone. Berliner, on the other hand, came into the field shortly after Bell and Tainter and ignored the work of Bell and Tainter as well as that of Edison, and followed other lines of development, namely, those which embodied the employment of a laterally undulating record of uniform depth, employing therefor the previous suggestions of Cros and embodying Berliner's improvements, which dispensed entirely with the objectionable mechanical feed mechanism for producing the rectilinear motion or feeding of the record relatively to the reproducer. He was only enabled to do this by the employment of an entirely different character of record groove than that employed by Edison and Bell and Tainter. Berliner, therefore, in my opinion, made a radical departure in the art of reproducing speech, when considering the distinctiveness of the features going to make up the operative-ness of the gramophone as compared with the features embodied in and essential to the machines of Edison and Bell and Tainter employing a vertically undulating groove.

Adjourned until Tuesday, Feb. 19, 1901, at 11 A. M.

PHILADELPHIA, Feb. 19, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of witness, R. M. HUNTER, resumed.

(Mr. Hunter continues his answer to Q. 11.)

Mr. Cameron refers to a knowledge of the laterally undulating record of uniform depth by Bell and Tainter as early as 1881, and this knowledge appears to have been obtained from the record of the American Graphophone Company v. United States Phonograph Company, et. al., in the District of New Jersey, which refers to a sealed paper alleged to have been deposited by Bell and Tainter in the Smithsonian Institution on October 20, 1881, and referred to in the said testimony in the year 1895, and following. Mr. Cameron quotes in answer to X Q. 34, a portion of the said alleged sealed paper of Bell and Tainter referring to the laterally undulating record. From this quotation it appears that the proposition was to cut either a vertically undulating record or a laterally undulating record, in wax, paraffine, or other similar substance, and that the phonogram so produced

"of either of these kinds may be copied in more durable material by any of the well-known moulding or electroplating processes; and the sound may be reproduced either from the original phonogram or from one of the copies."

In describing the formation of the grooves to be produced in the wax or paraffine, they say:

"The end of the cutting tool presses against the prepared substance, and cuts out a groove of considerable width, as the prepared substance is moved past the end of the tool."

This is the substance of all they have to say upon any development of the laterally undulating record, and it does not appear that they were ever successful in producing such a record, or that they ever seriously tried to do so. It will be noted, however, that their description of the groove is one

of considerable width, and this relative to the depth would accord very well with the actual shape of the groove in the graphophone as produced by them, and as illustrated in "Defendants' Exhibit, No. 26." It is evident that a groove of such gently sloping walls, while being excellently adapted for the vertically undulating record, would be practically useless for good commercial machines, were the same proportion of grooves employed in a laterally undulating record, and especially would this be so if any attempt were made to use such a record with a reproducer arm and appendages, such as employed in the Berliner Gramophone, with the object of making it feed itself automatically. In "Defendants' Exhibit, No. 26," the upper figure shows an enlarged section of the gramophone grooves, and clearly demonstrates the great difference in the characteristics of the two grooves, namely, those of the graphophone and those of the gramophone. To produce desirable results with a laterally undulating record the side or wall should be very steep and relatively contracted, so as to form quite a deep groove relatively to the width, the idea being to enable the style to be approximately in contact with each of the style walls at the same time, whereby they will always be in position to quickly operate upon the style in opposite directions. It will be seen that the graphophone grooves, when made of "considerable width," would not be at all suitable for a laterally undulating record, and, therefore, the mere suggestion of such a record in this sealed paper of Bell and Tainter does not convince me that they had any perfected ideas upon the subject, or seriously expected to be able to make such a record as a practical thing. All that they did was to make a suggestion which was not as clear or satisfactory as that in Cros's French publication, and one which would certainly not produce a record anywhere near approximating the gramophone record, as the suggestions of Cros would approximate such record. Even the Edison early patents have a suggestion of the production of a laterally undulating record, and while he describes means for producing such a

record, no one would assume that his suggestions were practical in this connection, or that satisfactory and practical results could be secured from them. Berliner's experience shows that it was not a self-evident and easy proposition. Assuming that Bell and Tainter did make such a suggestion as Mr. Cameron referred to, and to which I have referred to above, it seems to me that the suggestion does not demonstrate that they had any practical ideas upon the subject which are entitled to any specific consideration, but I rather lean to the opinion that they, like Edison, simply made a suggestion at that time without practically following it up. They abandoned their suggestions and bent their whole energies upon the vertically undulating record as is shown by the future work of those parties. Their suggestion is, therefore, hopelessly inadequate to have it read now into their patent 341,214, in suit as being included under the descriptions therein relating to the production of the record tablet, such as would be employed with the reproducer of the character shown in the patent. I would point out that Bell and Tainter nowhere mentions, directly or indirectly, in that patent, or either of the patents sued on, a suggestion regarding a laterally undulating record of even depth, and certainly the apparatus shown in the patent is totally unfit for producing such a record. The only record which it could produce would be one embodying the vertically undulating principle.

I have before pointed out that the lower drawing of "Defendants' Exhibit, No. 26," is an enlargement of the micro photograph of a section of a commercial graphophone record showing "Defendants' Exhibit, No. 23," and I will now say that the gramophone groove on "Defendants' Exhibit, No. 26," is an enlarged reproduction of the micro photograph "Defendants' Exhibit, No. 24," of a section of the commercial gramophone plate. "Exhibit, No. 26," therefore, permits a more easy comparison of the cross-section of the two types of grooves employed respectively by the complainants and defendants. The enlargements in these drawings are approximately two hundred times that of the original

grooves. Aside from the difference in the two grooves as to their width relatively to their depth and also to their great differences regarding the slope of their sides or walls, it will be observed that while the graphophone grooves coalesce and form ridges, the gramophone grooves are widely separated, the intermediate plateaus or level surfaces being mostly wider than the grooves themselves, and, in many cases, twice or more than twice as wide as the grooves.

Not only is the configuration of the two grooves strikingly different, but the operation of these grooves upon the reproducing style is also greatly different when reproducing recorded sounds. In the graphophone it is the bottom of the groove which operates upon the bottom of the style point, raising and lowering it rapidly, and the sides or sloping walls of the groove practically perform no function other than as guides to keep the style upon the bottom of the groove. For perfect operation there should be no lateral vibration of the style at all.

In the gramophone groove it will be seen that the side walls are very steep, and the steeper they are the better. The bottom of the groove in this case is level, and does not cause the style to rise and fall, but, is adapted to receive the entire weight of the reproducer arm and horn, and thereby remove all weight from the side walls in which the actual laterally undulating record is formed. In the graphophone the weight of the reproducer is received upon the record itself, whereas, in the gramophone it is not. The cross sections illustrated in "Defendants' Exhibit No. 26" are not adapted to give the full differences of the two grooves in a graphical manner, because the vertically undulating bottom portions of the graphophone grooves are not shown, and, likewise, the lateral walls of the gramophone grooves are not shown in their undulating character. This could only be shown by a series of sections. These two types of record grooves require a differently arranged reproducer to be used with them, and it will be observed that in the Bell and Tainter patent the diaphragm of the reproducer is substantially parallel to the

surface of the record, whereas, in the Berliner patents here in evidence, the diaphragm of the reproducer is at right angles to the surface of the record, and in a plane substantially parallel with the length of the grooves, this difference being necessitated by the different character of the grooves and the different mode of operation from the style. A record of the character of the gramophone would be wholly unsuitable for a machine of the type shown in the Bell and Tainter patent, and as constructed in the gramophone.

As before pointed out, Berliner arranged to feed his reproducer by the grooves themselves, as illustrated in Fig. 10 of patent 564,586, but finding that the rectilinear movement of the reproducer was not essential he resorted to a simple straight bar, pivoted at one end, on the universal joint, and carrying the reproducer head at the other end, which happens to be a very common expedient in the mechanical arts where a part is required to have capacity for a radical sweep. Such a construction is illustrated in the Edison English Patent 1644 of 1878. The arm was ultimately modified until it assumed the shape shown in "Complainants' Exhibit, Defendants' Machine," in which it not only supported the reproducer head but also the megaphone or horn. Substantially this construction is shown in Fig. 3 of the Berliner patent 534,543 of 1895 in evidence. The reproducer thus mounted is used by swinging the arm around by hand to insert the style of the reproducer into one of the grooves of the spiral record. The record is then rotated, and while the lateral undulations of the groove vibrate the style parallel to the face of the tablet, the style, reproducer head and arm, are propelled across the face of the tablet *so that the record groove itself becomes the feed spiral*, for the distance covering the entire series of record grooves, and thereby dispenses with all gearing, screws or other feeding devices previously required as in the Edison and the Bell and Tainter machines for securing the positive feed. The machine thereby becomes reduced to the smallest possible number of elements, and these are so simple that they can practically never get out of order.

While I consider that Mr. Berliner, by dispensing with the mechanical feeding mechanism and the employment solely of the laterally undulating record groove, produced a machine which was distinctive in character from those of either Edison or Bell and Tainter, nevertheless if his machine is to be compared to either of these parties, it more nearly resembles that of the Edison Patent 1644, of 1878, as it might be viewed from the light that he had coalesced the two spirals of the Edison structure, namely the feeding spiral and the record spiral; but even this is an assumption which I believe is straining the real conditions, as the difference in the construction of the groove itself is, in my judgment, a material element to be considered, in view of the extremely important part it plays in the feeding operation in connection with the weighty reproducing apparatus employed in the gramophone.

Mr. Berliner also spent considerable time in the development of a suitable cheap and durable record tablet which could be reproduced from the master record. The hard record of rubber or other suitable material, was finally the one adopted, and one of these is entered as "Complainant's Exhibit, Defendants' Sound Record." The making of such a tablet or record, is set forth in Berliner's Patent, No. 548,623, entered as "Defendants' Exhibit, No. 10".

Counsel for Defendant offers in evidence an enlarged tracing of the drawings of "Defendants' Exhibit, No. 11," of Edison's British Patent, No. 1644, of 1878, and the same is marked "Defendants' Exhibit, No. 35"

It is stipulated and agreed by and between counsel for the respective parties that the "Exhibit 35" just offered is a correct copy of the drawings of said Edison's British Patent 1644, of 1878, being the size of original drawings filed with the application for the said British Patent.

Counsel for defendant also offers in evidence Berliner Patent, No. 372,876, of Nov. 8, 1887, and the same is marked: "Defendants' Exhibit, No. 36."

Recess. :

Q. 12. Please consider now, particularly, the Bell and Tainter patent, No. 341,214, in suit, with respect to claims 19, 20, 21, 22 and 23; and give your understanding of the meaning and scope of these claims. Also state whether, in your opinion, these claims are broad enough to cover defendants' devices on any construction which would make these claims good and valid; and state your reasons for any opinion you may express.

A. I have carefully considered the Bell and Tainter patent referred to in the question, and more particularly with respect to the structures set out in claims 19, 20, 21, 22 and 23, thereof, and after a careful comparison of the devices employed in the defendants' machine, with the said Bell and Tainter patent, and particularly in connection with the aforesaid claims, I am of the opinion that the defendants' machine does not embody in its construction the invention specified in the said claims of the complainants' patent. I will give my reasons for this answer.

The claims in question have all reference to the reproducer part of the graphophone, and as the "record" as a means of operating the reproducing style, and with which it is adapted to co-act, appears in each of the claims, it is proper that the same should be considered as a means of determining what the structure called for by the claims shall be. As the record is made by a process that is independent of the reproducing devices, it is proper that we shall carefully consider the means for making the record with a view of properly arriving at an understanding of the word "record" and what it means in these claims, and what it demands of the other elements specified in the claims.

As I have before pointed out, the record groove of the Bell and Tainter groove is a minute groove having gently sloping walls and with decided elevations and depressions in the bottom of the groove, and decreasing in amplitude as we leave the bottom and approach the sloping walls which ultimately form the ridges between the grooves, and said elevations and depressions are most pronounced and are the real

effective portions where they occur immediately at the bottom of the groove. A groove of itself is not a sound record, and it is only when Bell and Tainter's grooves are provided with elevations and depression in the bottom that they become true sound records for reproducing under the method set out in their patent. Everything else about the record than the operative elevations and depressions in the bottom, is simply an incident of the cutting of the groove by the action of sound, and more particularly, in the case of Bell and Tainter by the particular perpendicular cutting style used by them. For example, the particular depth of the groove, and the sloping walls, are the result of the use of a specially shaped cutting style, and the manner of operating upon the wax surface with it, and these features are consequently incidental to the real or essential part of the record, namely, the production of the vertically undulating record. When, in the Bell and Tainter machine, the cutting style is not vibrated by sound waves, it still cuts a groove, a very shallow groove with sloping walls, but such groove would be of even depth, and contains no sound record, and no articulate speech could be produced from the same. This shows that a shallow groove with sloping walls is not the essential feature of the sound record, but if in its production the style is vibrated by sound waves, the groove of uniform depth is now made to have elevations and depressions in its bottom, and these, which are the only additions to the former groove, convert it into a true record. For this reason, I think it is proper to say that the vertical undulations in the bottom of the groove constitute the "sound-record." However, as the particular groove of the Bell and Tainter patent is so very shallow, that it is difficult to define strictly what is the bottom of the groove, and as the bottom and side walls blend into each other, and consequently, some of the irregularities at the bottom will extend to the side walls, it might be proper to designate this record of Bell and Tainter as "irregular groove with sloping walls," as stated in Claim 23, for while the walls themselves are not the record, still, with a specific statement

as that just quoted, defining the construction, the sloping walls may be taken as a portion of the structure, even though they are not the essential part of it.

The patent states, page 1, line 76-80:

"The invention consists, thirdly, in cutting or engraving the record in the form of a groove with sloping walls, the sound waves being represented by elevations and depressions at the bottom of the groove. * * *"

This is the only character of record which can be produced on the machines described and illustrated in the Bell and Tainter patent, and as it is impossible to make any other type of groove than one with elevations and depressions at the bottom of the groove, namely, one having vertical undulations, and with sloping side walls, it is but reasonable to suppose that was the character of record which was in the mind of Bell, and Tainter; and certainly that they had no other idea than a record in which there were "elevations and depressions" or, in other words, a "vertically undulating record" as the essential characteristics, is evidenced by the language of their patent. The method of making their record is clearly stated in Claim 2 which reads as follows:

"2. The method of forming a sound record by impressing the sonorous vibrations upon a style in a direction at right angles to the recording surface, and thereby cutting in a solid body a series of elevations and depressions of varying depth, corresponding in form to the sound waves, substantially as described."

Here we have a specific claim directed to the character of the record specified in the patent, and we find that it accords exactly with the third statement of invention, namely the cutting in a solid body of a series of elevations and depressions by the action of a style at right angles to the recording surface. It will be observed that the claim makes no mention of the walls, showing, again, that the sloping walls are largely incidental to the making of their record and due, more particularly to the special shape of the cutting tool, and the

formation of the recording surface upon which it operates. Under some conditions, the surface acted upon and the tool will produce the vertical undulations in a groove with sloping walls, but, under other conditions of the surface operated upon, the vertically undulating record will be formed without the sloping walls. For example, as shown in the Tainter Patent No. 341,287, dated May 4, 1886, and filed in August 1885. In this patent Mr. Tainter shows the tablet surface made up of spiral ridges and the record is cut upon the ridge of these ridges with vertical undulating characteristics. This 1886 patent, "Defendants' Exhibit, No. 37," shows that at the time of filing the Bell and Tainter Patent No. 341,214, in suit, these parties had under consideration the idea of forming their vertically undulating record in other ways than with the sloping side walls forming a groove, for, aside from their own work, as evidenced in this Tainter patent of 1886, they were aware of the United States patent to Reynolds, "Defendants Exhibit, No. 8," in which there is described a mode of cutting a sound record in the edge of a strip of material by vibrating that strip by sound waves against a rotary cutter. The record, thus produced, is not in the bottom of a groove, but is, in effect upon the top of a ridge, just as in the Tainter Patent No. 341,287, before referred to. They refer to the Reynolds patent on page 1, lines 37-45, as follows:

"It has been proposed to cut the record in the edge of a strip of metal or other solid material by vibrating the strip in contact with the cutting edge of a rotary disc-cutter; but this proposal is essentially different from this invention, the new mode being applicable to cutting the record upon all sorts of surfaces, and not upon strips only, and is, besides, believed to be later in time than this invention."

This statement is significant in two particulars, First, it shows that the cutting of a vertically undulating record upon a ridge was considered by them as having a direct bearing upon their invention, and as similar to their record broadly considered, and, secondly, the reference to the fact that their

invention anticipates Reynolds shows that they recognized the cutting of the undulatory record on a ridge as being of their own invention at the time of filing their patent, 341,214, in suit. While making this statement relative to the Reynolds manner of producing a cut record, Mr. Tainter filed his application in 1885, upon which patent, 341,287 was issued, on the same day with the particular Bell and Tainter patent here in suit, and in the said Tainter application, the idea of the ridges and the cutting of the undulatory record thereon, was most clearly shown as I have above pointed out. One of the claims of said patent reads as follows :

"7. A sound record in magnetic material having a spiral ridge, the irregularities constituting the record being formed in the top of the ridge, substantially as described."

It is quite clear, therefore, that Bell and Tainter had at the time of prosecuting their application upon which Letters Patent, 341,214, in suit, was issued, a clear idea of the cutting of a sound record without a groove as well as one with a groove, but, in both cases the record itself was still formed by elevations and depressions, and were vertically undulating. Keeping in mind, therefore, that Bell and Tainter recognized the possibilities of their invention, of engraving or cutting a record, to be capable of being carried out both with and without the production of sloping walls, I will return and examine the language of the specification upon which complainants' expert contends that the patentees included a laterally undulating record of even depth, and, under which, he contends the defendants' apparatus is made an infringement of the patent in suit.

In the suit of the American Graphophone Company *v.* Leeds *et al.* in the Southern District of New York, the Bell and Tainter patent was reviewed by Mr. Arthur S. Browne, expert, in behalf of the complainants, and, in describing the record of the Bell and Tainter patent, in his answer to Q. 6, he states :

"The conjoint action of the tablet and cutting style being to cut out a sound record in the surface of the recording tablet in the form of a spiral groove, having sloping walls, and an irregular bottom, the irregularities of the bottom corresponding in depth and shape with the loudness and characteristics of the impressed sounds."

And again on page 21, he stated :

"The sloping side walls of the sound groove have an important co-operation with the freely mounted reproducing point, since they automatically guide the point to the bottom of the sound groove, the irregularities of this bottom constitute the active sound reproducing agent."

These views show that the irregularities of the bottom of the groove are "the active sound reproducing agents" and that when they are to be used with the freely mounted reproducing point, they are employed in connection with sloping walls which latter act to guide the style to the bottom of the groove. Nowhere in his testimony does he imply that any other type or character of record could be produced by the apparatus shown in the Bell and Tainter patent, or could be utilized in connection with the reproducing devices shown, other than one having vertical undulations, namely, those of

"an irregular bottom, the irregularities of the bottom corresponding in depth and shape with the loudness and characteristics of the impressed sound."

As stated by Mr. Browne, Mr. Cameron, complainants' expert, does not wish to so regard the record of the Bell and Tainter patent, for obvious reasons, knowing that the gramophone record does not employ the vertically undulating characteristics, and insist that, while Bell and Tainter described only the vertically undulating record, they had in mind other sound records, and, for this reason, their claims, here under consideration, extend to the use of the reproducer in connection with sound records consisting of laterally undulating

grooves of even depth. He relies in support of his opinion upon certain words and phrases in the Bell and Tainter specification, and to which I will now refer. These particular parts are as follows :

"This invention relates to the formation, in a solid substance, of elevations and depressions, or *other inequalities* corresponding more or less perfectly to the form of sound vibrations, and the reproduction, by means of such inequalities, of the sound represented by them," (page 1, lines 9-14).

"The invention consists, thirdly, in cutting or engraving the record in the form of a groove, with sloping walls, the sound-wave being represented by elevations and depressions at the bottom of the groove or *otherwise*," (page 1, lines 76-80).

"The reproducing-style, mounted as just explained, is specially adapted for use in connection with a record in the form of a groove with sloping walls, and this combination is specifically claimed ; but it may also be usefully employed in connection with *other forms of record*," (page 1, lines 101- to p. 2, line 3).

"If one talks into the mouth-piece, I, the style will be thrown into vibrations corresponding to the spoken words, and the engraved line will be of varying character, the *inequalities or variations from uniformity representing the forms of the sound-waves*," (page 4, lines 26-32).

"The reproducer K, (shown in Figs. 7 and 8), for reproducing from the engraved tablet, or from *other suitable records*, the sounds which form said records, has a reproducing style, 26, formed of a narrow metal strip bent near the end, as shown in Fig. 8, and pointed as shown in Fig. 7," (page 4, lines 33-39).

In the above quotations, the *italics* are mine, and point out the particular parts which are relied upon by Mr. Cameron to include a laterally undulating record of even depth. None of these quotations refer to any other construction than irregularities of uneven depth in my opinion. The words, "or other inequalities" in the quotation from page 1, simply refer to these irregularities in the record which might be considered

other than true sinusoidal curves which are produced by theoretically perfect vibrations. The record is made up of uniform upward projections and depressions intermingled with various irregularities which are sometimes above and sometimes below the normal or neutral line which would be the level produced by the cutting tool if the surface is moved and the tool allowed to remain stationary. The other inequalities would be, as it were, the connecting portions to these true curves, such as might be produced in ending one word and beginning another, in which the sound changes, and when a gap is formed between two clearly defined sounds, such irregularities taking various forms and crossing the neutral line. The words "or other inequalities" therefore, simply refer to parts of the same record having the elevations and depressions, and do not, in my opinion, refer to any other type of record. Referring to the words "or otherwise" found in the second paragraph quoted, I understand them to refer to a vertically undulating record "and represented by elevations and depressions" otherwise than those formed in the bottom of a groove with sloping walls. That this is the meaning is self-evident when we remember that Bell and Tainter had a full knowledge of a record having elevations and depressions which were formed upon ridges. The statement in the third quoted paragraph to the effect that the reproducer while specifically adapted for use with a record in the form of a groove with sloping walls, "may also be usefully employed in connection with other forms of record," refers, in my opinion, to the fact that the hinging of the reproducer head and its style, on a universal joint, close to the style, may be used in connection with a record in which the groove is formed without sloping walls, but with the vertically undulating bottom, and also to a record of the character shown in the Tainter patent 341,287, "Defendants' Exhibit No. 37," and more particularly, with the notably old form of record known to them and referred to in their patent, namely, in the indented record of Edison in

tin foil, in which a groove was not engraved or cut, but with which the adjustable style and reproducer head could be employed. I am further of the opinion that this language to the use of the reproducer with other forms of record than the particular one specifically described in their patent was to include reproductions or duplicates by electro typing and other processes, hence, other forms than those produced by their machines on wax tablets, and in which their particular sloping walls were incidents of the production of the record. The next quotation, or that from page 4, lines 26-32, is so clearly stated as being the result of the particular apparatus shown in the patent that it needs no further consideration, because, it is an utter impossibility to produce any other form than a vertically undulating record with sloping walls with the apparatus shown and described in the patent. The words "or from other suitable record" found in the last quotation, has reference simply to any of the tablets having vertically undulating records whether in grooved form or upon ridges, where the same are not engraved, for example, the type known as the Edison indented tin foil record or records produced by duplicating processes, such as electro plating, plastic impressions, etc. None of these statements, therefore, will warrant any understanding that will include laterally undulating record or even depth, and in which the bottom of the groove is not formed with irregularities or vertical undulations. As I understand the Bell and Tainter patent, there is no reference whatever to a laterally undulating record of uniform depth, and from the nature of the invention illustrated in the patent, such a record could not be reasonably understood as being included, and in view of the explanations which I have given, is in my opinion excluded from a proper understanding of the said Bell and Tainter patent in suit.

Counsel for Defendant offers in evidence Tainter Patent No. 341,287 of May 4, 1886, and the same is marked: "Defendants' Exhibit No. 37."
Adjourned until Thursday, Feb. 21, 1901.

PHILADELPHIA, February 21, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of witness R. M. HUNTER resumed.

(Mr. Hunter continues his answer to Q. 12).

The claims of the Bell and Tainter Patent to which my attention is directed in the question are as follows :

" 19. The combination, with a reproducing style, of a mounting therefor, which leaves said style-face to move laterally and thereby adjust itself automatically to a sound record substantially as described.

" 20. The reproducer loosely mounted on a suitable support so that the reproducing style is capable of a lateral movement, and may in consequence thereof adjust itself automatically on the record substantially as described.

" 21. The reproducer mounted on a universal joint and held against the record by yielding pressure substantially as described.

" 22. The combination with a groove tablet or other body having a sound record formed therein, of a reproducer having a rubber style loosely mounted so that it is free to move laterally and thus adjust itself to the groove substantially as described.

" 23. The combination with the tablet or other body having the sound record formed therein, as an irregular groove with sloping walls of a reproducer, having a style for rubbing over said record and mounted on a universal joint substantially as described."

The word "style-face" appearing in Claim 19 is a typographical error, and should read "style free," as is self-evident. This is admitted and has been explained by Mr. Cameron, complainant's expert.

These five claims relate to substantially the same part of the apparatus, and while they differ somewhat in scope, they are nevertheless all directed to the automatic adjustment of the reproducer style in connection with a record of the character described and made upon the machine illustrated in the patent and more specifically designated in Claim 23 as

an irregular groove with sloping walls, and which irregularity is the vertically undulating record portion of the groove, as I have before pointed out, and the said improvements thus designated being employed in a machine of the character shown in the complainant's patent, namely, one in which the relative rectilinear movement between the record tablet and reproducer is mechanically produced by a screw or equivalent mechanical feeding device distinctive from the record tablet. These five claims may be grouped in two sets, namely, Claims 19, 20 and 22, as requiring the lateral adjustability of the style without regard to the presence or absence of the movement to or from the record, such as would be required by the universal joint of Claims 21 and 23. Claims 21 and 23 are in the other group, and are specifically directed to the reproducer, *per se*, being mounted on a universal joint, whereby it may be "held against the record by yielding pressure" and follow the record formed in the groove with sloping walls. Claims 21 and 23 refer to the short rubber section 32, in Figs. 8 and 13 exclusively, and is not answered by the construction shown in Figs. 18 to 20. The first group, namely, Claims 19, 20 and 22, while not requiring the universal joint, may be sub-divided into Claims 19 and 22 on the one hand, and Claim 20 on the other, the distinction between this sub-division being that Claims 19 and 22 are so drawn that they are directly applicable to the construction shown in Figs. 18, 19 and 20, wherein the reproducer head is fixed, and the style itself alone is flexibly supported, so as to be capable of lateral adjustment, while under a broad view of them they might be intended also to cover the possible lateral adjustment of the reproducer style through the adjustment of the reproducer itself through being supported on the small rubber tube, 32. In other words, Claims 19 and 22, under this assumption may be considered as more generic than either of the other three claims. Claim 20 is specifically limited to having the reproducer itself loosely mounted, so that the reproducing style is capable of lateral movement, and this claim, therefore, refers to the construction shown in

Figs. 8 and 13, without the necessity of the universal feature and excludes the construction shown in Figs. 18, 19 and 20. It will thus be seen that Claims 20, 21 and 23 specifically necessitate the adjustability to be for the reproducer itself, whereas Claims 19 and 22 do not require this limitation, but rather lean to the specific construction shown in Fig 20, since it is distinctly stated that it is the mounting for the reproducer style in Claim 19, and the fact that the style is loosely mounted in Claim 22. that the said style is free to move laterally, especially as the mounting for the style can hardly be stated to be the same as the mounting of the reproducer as the whole, because the style must have some character of mounting which is certainly independent of the mounting of the reproducer in carrying out the invention of the patent. The terms of Claims 19 and 22 are fully answered by the construction of Fig. 20, in which the reproducer style, 26, is secured to a thin rubber diaphragm, and in which there is no adjustment to the reproducer head, and in this I am borne out by reference to Fig. 10, which shows substantially the same manner of supporting the loosely mounted reproducer style. With regard to this, the patent states :

"The reproducer K¹, Fig. 20, is similar to that shown in Figs. 9 and 10, except that the style 26 is so placed that the point is at the centre instead of projecting beyond the edge of the instrument * * * * the thin rubber diaphragm, 38, gives a certain lateral play to the style."

Again referring to the reproducer K¹ the patent states on page 4, lines 117-123.

"The reproducer K¹ (shown in Figs. 9 and 10) has the style 26, attached to the outer of two light plates, 36 and 37, which are attached to the diaphragm 38, of thin sheet rubber, clamped at the edges between the ring 39 and the border of the back plate, 40. The tube 31 is fastened in the back plate."

This illustration of reproducer, Figs. 9 and 10, is as a substitute or alternative for the construction shown in Figs. 7

and 8, the difference being solely in the mounting of the style *per se*, the said mounting in Figs. 9 and 10 being such as to leave "said style free to move laterally and thereby adjust itself automatically to the sound record," as required by Claim 19, and also has "a rubbing style loosely mounted" on a reproducer "so that it is free to move laterally, and thus adjust itself to the groove" as required by the language of Claim 22. This construction of reproducer shown in Figs. 9 and 10, or as shown in Fig. 20, may be employed without the universal mounting, as shown in Fig. 20, or with the universal mounting, as shown in Figs. 8 and 13, said mounting being the universal joint embodied in the short piece of rubber tubing, 32. This view of the several claims is perfectly consistent with the invention disclosed and the patent practice in drawing claim.

Summarizing, therefore, Claim 19 is for the loose mounting of the reproducer style of Figs. 10 and 20, adapted for lateral adjustment with a sound record of the character produced in the machine illustrated. Claim 22 is substantially the same as Claim 19, except that it specifically brings into the claim the grooved tablet and the statement that the style is "loosely" mounted, which might be assumed as necessitating more freedom than would be answered by Claim 19. Claim 20 requires that the "reproducer" which carries the style shall be mounted so as to have slight lateral adjustability to permit the reproducer style to adjust itself to the record within the purview of a groove. This claim would be answered by Fig. 8, in which the reproducing style is not itself loosely mounted, but would have the lateral adjustment through the rubber tube, 32. The claim, however, does not restrict the style to be attached to the reproducer in any particular manner but would also include the mounting of the style in the other figure. Claim 21 is specific to a universal joint as being the immediate means of supporting the reproducer on its floating arm, 33, 19, and therefore, would include the construction under Claim 20, the "universal joint" being a small piece of rubber tubing, 32; the said reproducer, so

mounted, being adapted for the use with a record of the character set out in the patent and capable of being made by the apparatus disclosed therein. Claim 23 is substantially the same as Claim 21, but with the particular record tablet made a specific part of the claim.

Recess.

To graphically illustrate this summary of the claims 19 to 23, of complainants' patent I produce a series of sketches or diagrams graphically illustrating the essential characteristics of each of the claims, the numbers of the claims being arranged adjacent to the corresponding figures, and the figures being further lettered to correspond to the similar parts in the complainants' patent, and also coupled with such remarks as are thought to be more clearly explanatory of the parts. In this series of diagrams I have indicated the universal joint, 32, as a joint with vertical and transverse axis in place of the short piece of flexible rubber tubing for the purpose of indicating at a glance whether the reproducer head is to have lateral movements alone, or such lateral movement and also movement in a vertical plane at right angles to the record surface. In referring to this diagram, I would point out that the parts 33, 19, 20, are nothing more than the old pivoted or floating arms of the Edison prior patents in England and the United States, and that the universal joint or provision for lateral automatic adjustment of the reproducer head on the arm 33, 19, is entirely independent of the old joint or hinge, 20, of the arm, and is located immediately between the reproducer and the free end of this arm. In the diagram I have not shown the remaining element of the machine, as it is not necessary, but it is to be understood that the improvements here shown for the support of the style and the immediate support of the reproducer head, is intended for use and performs its function in use, in a machine having a mechanical feed mechanism for producing the relative rectilinear motion between the reproducer and record tablet, and which mechanism is located at a distance from the posi-

tion of contract of the reproducer style with the record. I emphasize this, as the distinctive class of machine to which the improvements of the complainant's patent are alone adapted, because it is only in this class of machine where any necessity could possibly arise for the automatic adjustment of the style of the reproducer within the purview of a groove of the record tablet, and, moreover, this was the only class of machine which had been developed at the date of the complainant's patent. The structure of these claims 19 and 23, therefore, does not apply to the class of machine embodied in the gramophone (the defendant's machine), because, in that case the feeding of the reproducer itself is performed by the style acting in the groove of the record tablet, and, consequently, as these two parts must, of necessity, be at all times in contact, and in proper relation, the necessity for such automatic adjustable features as embodied in the claims 19 to 23, of the complainant's patent, does not exist.

Counsel for defendant offers in evidence the sketch referred to by the witness, and the same is marked "Defendants' Exhibit, No. 38."

(Witness continues.)

The views which I have above expressed are thoroughly borne out by an examination of the construction of the machine illustrated in the drawings of complainants' patent. Claims 19 and 22 being wholly answered by Figs. 18, 19 and 20, disposes entirely of any necessity of the use of a floating reproducer or a universal support therefor. Claims 20, 21 and 23, while requiring the possibility of the slight lateral adjustment of the reproducer to enable the style to keep its proper position in the record groove, while the said groove is mechanically fed to the style under the operation of external mechanical feeding devices, it is evident that if the mechanical feeding mechanism were removed there is no possibility of the reproducer being mechanically fed over the record tablet, to perform the rectilinear movement necessarily

required between the reproducer and tablet. The nature of the construction of the complainants' machine would absolutely preclude any such a feeding movement of the reproducer. The patent does not say anything about feeding the reproducer, but merely to the effect that the style shall adjust itself to the record in the bottom of the groove, which is a function developed only because of the presence of the external mechanical feed and the difficulties and defects which are introduced into the machine by its employment.

Another evidence of the fact that the lateral adjustment is simply such an adjustment as is necessary within a purview of the groove, is found in the patent itself, for, as I have shown, the patentee, in Fig. 20, and also Fig. 10, provides a construction whereby the style may have the so-called "lateral movement" to "adjust itself to the groove," while the reproducer head is held against any lateral adjustment, and yet this construction answers Claims 19 and 22. I have also shown that in place of securing this minute lateral adjustment of the style directly by the style mounting, the style may be more rigidly supported, as in Fig. 8, but, in that case, the said minute lateral adjustment must be secured by providing the adjustable mounting for the reproducer head, as called for by Claims 20, 21 and 23. It requires no argument to show that the adjustment of the style in Figs. 10 and 20 would only be of a capacity practically of one groove, and as this is the extent of the adjustment necessitated by the invention of the Bell and Tainter patent, it is not only reasonable, but proper, that the adjustment of the so-called universal joint of the reproducer head should produce the same possibility of adjustment of the style, namely, within the purview of a groove. This, in my judgment, is the only proper and correct understanding of the invention disclosed in these claims.

The specification throws further light upon this subject in the paragraph beginning with line 68, page 4, which reads:

"There exists always a liability to disarrangement

in some part of the machine either in the recorder or the support therefor, or the recording tablet, or its support, or if there be no disarrangement it would be difficult to insure that the reproducing style should touch the record precisely at the proper point if the reproducer be held rigidly. Difficulties on these accounts are avoided by the loose or flexible mounting of the reproducer, the style automatically adjusting itself to the proper place on the record. It will be seen that the reproducer is mounted on a universal joint, so that it can move in any direction. The movement parallel to the face of the tablet would, however, by itself allow the style to follow and adjust itself to the record to a useful extent."

I understand this paragraph to refer to the difficulties which I have before pointed out which in a machine of the character shown in the complainant's patent, namely, one having an external mechanical feed, which would cause a relative abnormal displacement of the "record" groove relatively to the style, and to show that by virtue of this particular universal adjustment of the reproducer, these difficulties are avoided, "the style automatically adjusting itself to the proper place on the record," that is to say, that portion of the record which is immediately at the bottom of the groove having the sloping walls. This adjustment, therefore, would have a maximum requirement of less than the width of a groove. It is also to be noted that the above quotation speaks of accomplishing this result if the joint supporting the reproducer has only provision for lateral adjustment. This is in accordance with Claim 20, and, as is shown graphically in Exhibit 38. It does not refer to the illustration, Fig. 20, because this paragraph particularly refers to the immediate mounting of the *reproducer per se* and not the style, the latter being here considered as an incidental part of the reproducer. The only understanding which can be taken from this language above quoted is that the "universal joint" there considered is wholly independent of the joint of the floating or hinged arm 19, which is hinged to the main frame of the machine at 20, the said hinge arm for

the reproducer being simply the old hinge arm found in the Edison English patent of 1644, except that the Edison arm has not only a hinge corresponding to 20, but also a hinge at right angles to that, making it a complete and perfect universal joint, but *not the universal joint referred to in the above quoted paragraph of the complainant's patent.* The complainant's universal joint found in the small piece of soft rubber tubing, 32, is an addition to the mechanism of the Edison machine, and is not a substitution or alternative construction, and is required more in the Bell and Tainter machine than in the Edison machine, because, first, the grooves are finer and hence more difficult to track, and second, the external mechanical feeding mechanism introduces more elements liable to produce lost motion, and the presence of the defects pointed out in the paragraph last above quoted. The adaptation of the universal joint for supporting the reproducer upon the free end of the hinged or floating reproducer arm, of the Bell and Tainter patent, to the structure of the Edison phonograph of his English patent, 1644 is graphically illustrated in the drawing which I produce, Fig. 1 thereof representing the tablet reproducer and supporting arm of Figs. 1 and 2, the said arm having a universal joint or hinge at 5, 6, on the main frame of the machine, and Fig. 2 representing the cylindrical tablet, reproducer head and reproducer supporting arm shown in Figs. 12 and 15 of said Edison English patent, the supporting arm in this case being hinged upon a transverse axis 1', parallel to the surface of the record tablet as in the case of the complainant's patent. Similarly the axis 5, in Fig. 1, is parallel to the axis of the record tablet and consequently also corresponds to the hinge 20 of the arm 19 of the complainant's patent. In both of these figures 1 and 2, I have introduced at 32, the soft rubber universal joint between the free end of the arms and the reproducer, and it was the introduction of this universal joint to permit the slight lateral adjustment of the style upon the record irrespective of the mechanical feeding of the supporting arm or of the record

rectilinearly by external feeding mechanism, which latter is essential not only to the Edison machines but also to a proper understanding of the complainant's patent in suit.

Counsel for defendant offers in evidence the drawing produced by the witness, and the same is marked :
"Defendants' Exhibit, No. 39."

(Witness continues.)

As it is important that the exact position and scope of this universal joint 32 of the complainant's patent be definitely established, I will take occasion to add to what I have already said by showing from the complainant's patent itself that the said universal joint is not to be construed in any sense equivalent to the joint of the supporting arm hinged or jointed to the main frame. In the construction shown in the complainant's patent, the recording instrument and the reproducing instrument are alternately supported upon the same supporting arm, 19, hinged at 20, so that any description regarding this hinged arm is pertinent. While it is nothing but the Edison hinged arm adopted by Bell and Tainter, just as they adapted almost their entire construction, from the English patent of Edison, we will see what they have to say about it.

Referring to the arm, the patent states (page 3, line 96):

"The lower part 19, of this standard, is hinged in the bracket 20, as clearly shown in Fig. 2, so that it can be rocked to bring the recorder into or put it out of action * * *."

"On the tube or standard, 19, is a ring weight, 2, which is retained in position by a set-screw, 127. It therefore can be adjusted up or down, in order to *increase or diminish the pressure* of the style 11 against the tablet F. The use of this weight is desirable but not necessary * * *."

"In operation the recorder rests by its own weight, assisted by the pressure of weight, Z, or by its own weight alone, if preferred, against the recording tablet F, * * *. The sonorous vibrations impressed upon the style are so rapid, as well as so minute, that the

record is made as perfectly as if the recorder were held positively, while at the same time the recorder can be moved bodily to conform to the unevenness of the surface of the tablet * * *."

This description is an exact description of the recording and reproducer arms of the Edison patents, not only his English Patent, 1644, but also his American Patent, 227,679, "Defendants' Exhibit, No. 6." This pivoted arm 19, hinged at 20, weighted or not, is, according to this description, not the reproducer, nor is it in any sense, directly or indirectly, a part of the "universal joint," which directly supports the reproducer head. The patent continues and states that the recorder is removed from the hinged arm 19, and the reproducer is substituted. This is stated on page 4, line 55, etc.

"For use the tube 33 is slipped into tube 19, in the manner shown for the tube 18 of the recorder.

"The reproducer K when so placed is mounted upon a hollow standard composed of the tubes or tubing, 31, 32, 33 and 19, and *in consequence of the flexibility of the rubber tubing, 32*, it is free to follow the record. No special care is necessary to insure its adjustment, for if the reproducer K were allowed to rest against the record, with the style upon the engraved line the style will of itself gravitate to the bottom of the groove."

The above part, which I have placed in italics, shows that the capacity of the style to gravitate to the bottom of the groove, namely, to automatically adjust itself to the record, is due to the presence of the universal joint produced "in consequence of the flexibility of the rubber tubing, 32." It is not due in any sense to the arm and its hinged joint, 20, for in the use of this arm its hinged capacity is the same as that in the prior art, particularly the Edison machine, to enable the reproducer to be pressed upon the surface of the record tablet, which function was an old and well known one and is clearly not to be confused with the special idea and invention of the complainants' patent involving the use of the universal joint for the reproducer as distinguished from the arm for the purpose of securing the delicate adjustment of the style laterally both relatively to the record tablet and

the supporting arm carrying the reproducer, whereby the said "style will of itself gravitate to the bottom of the groove." That is to say, the style attached to the reproducer head is induced to so gravitate by virtue of the flexible rubber tube, 32, carrying the reproducer head, independently of any movement of the hinged arm 19. Further, referring to the invention, of this universal joint, the patent states, on page 1, line 88, etc.

* * * "The reproducing instrument, is mounted on a universal joint and the style is pressed against the record by the yielding pressure of a spring or weight. Practically, in the instruments made by us the pressure is due to the weight of the instrument, modified by the elasticity of a section of soft rubber tube, which supports the same and constitutes a universal joint. * * *"

This language is very clear, as showing that the "universal joint" is to be confined to the soft rubber tube, and is not to include the part which carries the weight. The part which carries the weight is the tubular arm 19 hinged at 20, and this under the action of the weight Z presses the style against the record. As the reproducer carrying the style is connected to the tube carrying the weight Z, the action of said weighted arm 19, and its weight, is "modified by the elasticity" of the said soft rubber tube which constitutes the whole of the universal joint specified in the claims mentioned in the question. The weight of the instrument mentioned in the above quotation as pressing the style upon the record of course will also include the weight of the reproducer itself, but this is simply an addition to the weight Z and hinged arm as will be seen by referring to the quotations above on page 3, line 96, etc. Of course the action of this weight in pressing the style upon the record will be modified to some extent by the interposed rubber tubing, but neither this weight, whether it be the arm 19, the weight Z, or the reproducer itself, constitutes in any sense the universal joint, or any part of it, since it is very clearly stated that the "section of soft rubber tube" constitutes the universal joint, and this is an entirely distinct thing from the parts constituting the arm 19.

Adjourned until Friday, February 22, 1901, at 1 P. M.

PHILADELPHIA, February 22, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of witness, R. M. HUNTER, resumed.

(Mr. Hunter continues his answer to Q. 12.)

As I have before pointed out, a lateral movement to the style as the additional movement under the patentee's invention in this old class of machine is all that Claims 19, 20 and 22 require, and this is admitted by Mr. Cameron in his answer to X Q. 193 when asked if it is true that lateral freedom of the reproducer to any degree parallel to the face of the record, would enable the style to adjust itself automatically to the record. He says :

"A. I think it is, though I should not regard a reproducer which was rigid so far as vertical movement was concerned and free only to move parallel with the face of the tablet, as being an ideal construction. The preferable form would certainly be the loosely mounted reproducer whereby it is enabled to float, as it were upon the surface of the record, responding as a whole to the grosser irregularities of the tablet, and always maintaining the reproducing style in position to be accurately operated upon by undulations of the record groove."

This statement is in accord with what I have pointed out is contained in the patent, the loosely mounted reproducer capable of floating, as he terms it, is answered by Claims 21 and 23. I would point out, however, that in these claims, 21 and 23, as well as Claim 20, it is specifically required that the reproducer itself shall be loosely mounted or held by yielding pressure, and it is not the supporting or carrying arm 19, which is to be so loosely held, or have provision for the said universal movement, and this is in accord with the prior art since the Edison Patent 227,679, "Defendants' Exhibit No. 6" shows a floating arm carrying the reproducer and hinged so as to move to or from the surface of the record tablet, similarly to the arm 19 of the Bell and Tainter Patent; also the Edison English Patent 1644, "Defendants' Exhibit No.

11" shows the employment of such an arm as last mentioned and also in Figs. 1 to 11, the reproducer carrying arm hinged upon a universal joint found in the parts 5 and 6. I would observe that Complainants' expert, Mr. Cameron, has repeatedly asserted that the handle device arranged between the words, Fig. 1, and the pivot 5 and extending obliquely upward and to the left in Fig. 1 of this Edison patent, is a hand clamp for clamping the lever I carrying the reproducer head rigidly against movement to or from the record tablet when the machine is in operation, and, therefore, the said arm pivoted at 5, becomes, as it were, a rigid arm, pivoted only at 6, and capable only of being fed parallel to the record tablet. I am of the opinion that he is wholly in error and further, that it is an absolute impossibility in the construction illustrated in Figs. 1 and 2, for the said part to act as a clamp for holding the arm I against free play vertically. I have made many thousands of mechanical drawings in my time and, perhaps, am as familiar with the art of mechanical drawings as any one in the country, including both illustrative drawings for letters patent and working drawings for the construction of machinery, and I make the positive statement that there is nothing in this Edison Patent 1644 that warrants any such understanding as that injected into it by Mr. Cameron, but, on the other hand, the construction is illustrated is such that it clearly refutes any such understanding as that claimed by Mr. Cameron. As I understand this part, it is simply a clamp in the form of a screw which may clamp the arm I when the outer end thereof is depressed and the reproducer end thereof is considerably raised, under which condition the body part of the arm will be raised sufficiently to be reached and clamped by the screw. When in this position the swinging of the parts about the vertical axis 6, will not permit the style or reproducer to strike the turntable of the machine, and thereby accidental injury would be avoided when the machine is not in use for reproducing. When the machine is in condition for reproducing the arm I, is free to swing about the transverse pin 5, and also about the vertical pin 6, the said

two pins acting as a universal joint. I would also point out that in Figs. 6 to 10, no clamp whatever is shown, thus indicating that it is only an unimportant auxiliary in the completed machine. In the Bell and Tainter patent, the arm 19, is so pivoted that when thrown back the action of gravity holds it back, and, thereby obviates the necessity of employing a clamp. The clamp in the Edison patent is certainly not clearly shown, and there is no description whatever of it, nor any reference made to it in the patent itself, consequently, Mr. Cameron is wholly unjustified in attributing to it functions which are absolutely inconsistent with what is shown or a common sense understanding of the drawing, and mode of operation of the machine. The Edison reproducer is carried on the end of a floating arm which arm is hinged on a universal joint, and the reproducer is free to follow all irregularities in a vertical plane to the surface of the record.

The art, therefore, shows that there is nothing new in broadly hanging a reproducer through an arm to the main frame by a universal joint, and, consequently, claims 19 to 23, could not have any such broad understanding *without being fully anticipated by the prior art*. The claims, however, refer to the immediate mounting of *either the style itself or the reproducer itself*, and does not refer to the mounting of the old hinge arm upon the free end of which the reproducer is carried. On the other hand, the mounting of the reproducer is the immediate connection between the reproducer itself and the end of the arm or carrier which, in some types of machines, is part of the mechanical external feeding mechanisms for the reproducer in feeding it rectilinearly across the record tablet. This character of feeding is clearly shown in the Edison English patent, 1644, in Figs. 1, 2, 6, 7, 8, 9, 10, 11, 12, and 15, and also in Figs. 3 and 4 of the Edison Patent No. 227,679. In the particular illustration of the Bell and Tainter patent, they have, for convenience, arranged to feed the tablet in place of the arm carrying the reproducer, this being a well known expedient in the art as the alternative and equivalent of feeding the reproducer sup-

porting arm. This particular idea is also shown in the Edison English patent, No. 1644, in Figs. 13 and 14, and in the Edison English patent, 2909, of 1877, and likewise in the American Edison patent, 200,521 and 227,679, all in evidence in this case. It thus appears that the means for holding the reproducer, and feeding the rectilinearly across the reproducer, or holding the record tablet and feeding the reproducer rectilinearly across the tablet, are the old features which make up the mechanical feed exterior of the record itself. I would call attention to the fact that while the Bell and Tainter patent in suit show the record as being mechanically fed rectilinearly past the reproducer, the gramophone machine manufactured by the complainants under this Bell and Tainter patent, mechanically feeds the reproducer, thereby confirming my views on the equivalency of these two methods of feeding. The universal mounting for the reproducer is certainly to be something in addition to the reproducer carrying arm, in view of the prior art. It is shown as something in addition, namely, a small piece of flexible rubber tubing close up to the reproducer head, and is the immediate support of the reproducer head upon the arm. This is in exact accord with what I have before stated and what is graphically illustrated in "Defendants' Exhibit, 39."

This adjustability of the reproducer, while contemplating a very small adjustment, namely, one equal to perhaps a hundredth part of an inch, is greatly magnified and enlarged by the complainants' expert, so as to include a capacity for automatically feeding the reproducer entirely across the record. No such idea as this can be found anywhere in the patent, but it was necessary to take this distorted view of the invention for the purpose of including the defendants' machine under the terms of the claims. This position of complainants' expert is, in my opinion, wholly untenable, and incompatible with the art, and the real invention disclosed in the complainant's patent. It contemplates dispensing with the external mechanical feeding devices, and the introduction of a feeding capacity to the record tablet, and an adjustable capacity to

the immediate mounting of the reproducer of the complainants' patent, which, as a matter of fact, it has not got, and for which no statement can be found in the complainants' patent. Every one of the claims, 19 to 23, are to be read in connection with a machine of the character disclosed in the patent, and ending, as they do, with the words, substantially as described, they are to be read as if relating to a special improvement for mounting the reproducer and style directly upon the old supporting arm and in a machine which has an external mechanical feed, the latter being relied upon to at all times maintain the reproducer in alignment with the successive spirals of the record. The patent states that the freedom of universal movement to the style and reproducer is required as an additional feature, in order to allow the style to adjust itself automatically to the record, or, in the terms of the specification ;

"so that it is free to follow the sound record of phonogram "

or so that

"it is free to follow the record "

or so that

"it will gravitate to the bottom of the groove "

or, again, so that the style will automatically adjust itself

"to the proper place on the record."

As I have before shown, the "sound record," the "record," the "bottom of the groove," relate to the undulating bottom or that portion which is directly the means of producing the vibrations of the style. If the style is to gravitate to the bottom of the groove, it is very clear that the possible capacity for adjustment would not have to be more than one one-hundredth of an inch, and as the style is shown as projecting beyond the reproducer head, it is evident that the centre of the diaphragm would probably not have to have capacity for adjustment of more than sixty per cent. of this. Now, while there appears to be no difference between the views of Mr. Cameron and myself as to the idea of the adjustability with regard to the style, gravitating toward the bottom of

the groove, or of adjusting itself to the proper place on the record, he takes a very much more comprehensive view of the words in the first two of the above quotations. As I understand him, he considers that there is a distinction between the capacity of the style to follow the sound record and the capacity of the style to adjust itself by gravitating to the bottom of the record. This distinction, he thinks, warrants him in assuming that asserting that to follow the sound record as stated in the patent in suit, warrants him in assuming that it means such an adjustable capacity as would also include the positive feeding of the reproducer transversely across the record by the record itself. I do not agree with him, and believe that his contentions are wholly inconsistent with any reasonable understanding of the patent in suit. If these words "free to follow the sound record" could not be explained on any other understanding, there might be some excuse for such a comprehensive construction being given to the invention, but as these words clearly and concisely express the real and true capacity for adjustment, namely, one within the purview of a groove; as I have before explained, I am of the opinion that said words should be restricted to such an understanding. In the machine disclosed in the complainants' patent, as in all other machines prior to the gramophone, the defendants' machine, the successive spirals or helices making up the continuation of the same record groove, were successively brought into proper relation with the reproducer by an external mechanical feeding device, and, in all of these machines, the groove and the record formed therein was fed longitudinally under the style of the reproducer. Now, the only thing which was left for Bell and Tainter to invent was to provide some delicate adjustment for the style directly or through the immediate support of the reproducer itself, which would give a slight lateral play to the style sufficient at least that any slight irregularity or so-called "drunkenness" in the record groove, or any slight displacement of the record tablet upon the turn-table or its carrier, could be compensated for by this automatic adjust-

ment capacity of the reproducer style or reproducer. In a record cylinder of the character employed in the graphophone machine, it is quite evident that no drunken record groove would ever be more out of alignment than the width of a groove, namely, one one-hundredth part of an inch, and it is also evident that any adjustment of the same upon its carrying cylinder would only be out of alignment with the reproducing style something less than the width of one groove or one one-hundredth part of an inch, and this displacement might either be due to the longitudinal adjustment of the tablet upon its carrier, or due to the adjustment about its axis, or to both, but, in any event, its limit is approximately one one-hundredth of an inch. These, then, are the irregularities which must be compensated for by the loose mounting or universal joint for the reproducer, and it is evident that the capacity for adjustment is so minute that it is of a character totally different and entirely distinct from anything which contemplates the feeding of the reproducer transversely across the record.

That this view is correct is established by the patent itself, because it has been clearly pointed out, and admitted by the the complainants' expert, that the lateral adjustment of the style or reproducer alone, will perform the function of following the record, and when we examine Figs. 18, 19 and 20 of the patent, we find that this is carried out. In this case, we have the record groove instead of being in the spiral, arranged as a straight line on a long tablet. Of course, this record groove may have "drunken" portions in it, and is fed longitudinally under the reproducer just as the spiral groove is fed longitudinally under it. In the case of the long strip record, we have the capacity due to the loose mounting of the style to enable it to gravitate to the bottom of the groove and also "to follow the sound record," conforming, therefore, to the exact words employed in the specification, and some of which I have quoted, and yet, in this construction, namely, Figs. 18, 19 and 20, it is quite evident that there is no transverse *feeding* of the reproducer across the record from one

groove to the next, and so on. It follows, therefore, that the statement that the reproducer "is free to follow the record," simply means that the style of the reproducer is free to maintain its position in the bottom of the groove, namely, upon the record, and follow that particular portion of the groove as the said groove is fed longitudinally under it, and this is true whether the groove is formed in a long strip, or whether it is formed in a spiral, and the different spirals advanced transversely so as at all times to keep the groove approximately under the reproducer. The understanding, therefore, which I have of the words quoted, is that the capacity for adjustment is the minute lateral movement which enables the point of the style to gravitate to the bottom of the groove, and upon the record itself; and the statement regarding the capacity it had whereby "it is free to follow the sound record," relates to this slight lateral flexibility which enables the style to retain its position in the middle of the groove or upon the sound record during the continued longitudinal travel of the groove under the style. The capacity of adjustment and freedom to follow the record, are therefore, one and the same thing when applied to the mechanism which permit these functions to be performed, the said mechanism being either the special mounting of the reproducer style itself, or of the immediate mounting of the reproducer found in the small section of soft rubber tubing. No reasonable understanding of the language employed in the Bell and Tainter patent, will warrant any other understanding than that which I have above expressed; and under no conditions, could the language of the patent be assumed to mean that this small capacity for adjustment, whereby the style may follow the record in the groove, should have such an extended meaning as to introduce the capacity of the mechanical feeding of the reproducer across the series of spirals of the record tablet, and eliminate the external mechanical feeding devices which are shown and described as essential features of the organized machine; as such an attempt would in my opinion, necessitate abnormal expansions of the meaning of the words

employed, would import into the patent capacities and ideas wholly foreign to it and would eliminate the external mechanical feeding features which are so fully and precisely described, and which, even to the present time are employed in the machines made under the Bell and Tainter patent. It would introduce the inconsistency of eliminating from the patent, as useless, the external feeding mechanisms, the dispensing of which is not even vaguely hinted at in the patent or considered as a bare possibility, and which were never dispensed with in any organized machines of the prior art as it existed at the date of the Bell and Tainter patent.

Before leaving the claims, I would point out that in Claims 19, 20, and 22, the lateral movement of the style or reproducer, is stated to be for the purpose of enabling the style to "adjust" itself to the sound record, and if there is any distinction between adjusting and following the record, it is clear that these three claims do not refer to following the record. Claims 21, and 23 are silent as to whether the capacity is for adjusting the style to the record, or for following the record. In view of this, it would be unfair to import into these claims, any understanding which would contemplate transversely feeding the reproducer across the record as distinguished from the mere adjustment of the reproducer style to the record within the purview of a groove, I believe that my understanding of the words "adjust" and "follow the record," that is, that they are one and the same thing, or relate to one and the same mechanism, is correct, and that the mechanism is the particular mounting for the style or reproducer itself upon the end of the supporting arm, 19, and which mechanism is to be employed as an adjunct or in addition with the external mechanical feeding devices in the organized machines, substantially as described in the patent.

Having now considered the Bell and Tainter patent, with particular reference to Claims 19 to 23, I will consider the defendants' machine and compare the devices shown therein, with the structures claimed in the said claims of the Bell and Tainter patent. I have already briefly referred to

the development of the gramophone, and more particularly of the character of record tablet employed therein, so that it will only be necessary for me at this time to refer to in detail to the reproducing devices. As before stated, the record is on a disc of hard rubber, or similar compound, and is represented as a spiral groove of even depth, but undulating laterally. By reference to "Defendants' Exhibit, No. 24," and by reference to "Defendants' Exhibit, No. 26," I have pointed out that the gramophone grooves are, by comparison with the graphophone grooves, very narrow and very steep; but in order that the relation of the style used by the defendants to the record grooves used by them, be well understood, it is perhaps necessary to consider the two together. The defendants' style is a steel needle, sharply pointed, and is of such size at its point that it does not quite fill the groove. When held in the groove it touches the bottom thereof, but does not make contact with the sides. In "Defendants' Exhibit, No. 29" we have, on a very large scale, the reproducing style used by the defendant, shown in its relation to the record groove. On account of the great enlargement, the point of the style appears to be rounded, but this would be the case with all sharp points if sufficiently magnified. Fig. 1 shows a style before it has been subjected to wear in the process of reproduction, it being in position in the groove of the tablet. It will be noticed that the style rests upon the bottom of the groove, and is not in material contact with the walls of the same. In the defendants' machine the style is not vertical when in the record groove, but is inclined toward the plane of the tablet, as will be more fully understood by reference to "Defendants' Exhibit No. 31." In thus making the point of the style smaller than the full width of the record groove, Mr. Berliner simply followed what Edison had done in this regard and what was open to others to do. In the case of the graphophone grooves, namely, those of Bell and Tainter, it is comparatively easy to secure record grooves of approximately uniform size and shape, and it is therefore easy to make the reproducer style narrower at its point than the

width of the record groove. This is due to the fact that the cutting of the groove is made with means of definite dimensions. In the case of the gramophone record, however, the width of the groove depends largely upon the action of an acid which is always more or less erratic and uncontrollable, and consequently, in view of this uncertainty as to a definite width of record groove, the point of the reproducing style has to be made as small as practicable and consistent with strength to be sure that it will be narrower than the width of the record groove. While this is the initial form of the style, the form changes from moment to moment during the sound reproduction because the hard rubber record acting upon the soft metal style, grinds off not only the extreme point, but also the sides thereof, so that in a few seconds after the style is put in operation the point has entirely changed in shape. This change is in a general way illustrated in Figs. 1, 2, 3 and 4 of "Defendants' Exhibit, No. 29." By reference to these figures it will be seen that the style point is ground off obliquely and that a tongue is formed at that point, which tongue extends diametrically across the point of the style, so that at the base of the tongue there is formed a flat ledge on each side of the tongue. The style now rests with these ledges on the tablet, with the tongue extending into the record groove. This change of form of the point of the style is due to the fact that the hard rubber contains fine granules of sulphur and other substances that are harder than soft steel, of which the style is made, and therefore acts as a grindstone, the grinding action being almost continuously on the bottom and on the shoulders above the tongue, but intermittently on the sides, because, in the act of reproduction, the undulating side walls strike the opposite side of the style alternately, and with each impact the grinding action is continued.

This grinding off of the style point takes place so rapidly that after a few seconds the style is substantially supported upon the ledges upon the face of the tablet, since the bottom of the style has been ground away more rapidly than the ledges, and would be substantially clear of the bottom. The

support of the style on the ledges is illustrated in Fig. 2 of Exhibit 29, the tongue of the style is now considerable narrower than the width of the groove, so that when it is just in the middle of the groove it will touch neither the side walls nor the bottom. While the ledges continue to be ground off, the bottom is kept fully ground so that, as a matter of fact, the ledges do the main supporting when this condition of the style is arrived at. In a very short time the style has to be thrown away and a new one inserted, as one style is only useful on account of its grinding action, for the reproduction of two or three selections.

The movement of the tongue of the style from one wall of the groove to the other, and back again, is the movement by which the recorded sounds are reproduced, these movements being communicated to the diaphragm of the reproducer. It will be seen from this that the bottom of the groove has no function in the reproduction of the recorded sounds, since it gives no movement to the style. The walls of the groove impart all of the movement and are, therefore, the sole agents for giving to the style its vibratory movements.

It follows from this that the style does not rest upon the record since the record is in the sides alone, and consequently is where the style cannot rest. These side walls, as before stated, come in contact with the opposite sides of the style and alternately, so that at no time can the style be simultaneously in contact with the entire record. The operative part of the record is partly in one side wall and partly in the other side wall, and from what I have said above, it is seen that the style cannot simultaneously be in contact with both of these side walls or record portions, and also that there are times when it is in contact with neither of them, but at no time in the operation of the instrument does the point of the style rest upon either of these portions of the record. The pressure of the point of the style upon the bottom of the groove, at the beginning of the reproduction, only acts to support the weight of the reproducer, the carrying

arm and horns and does not aid directly in the reproduction, because it does not rest upon any record. As a matter of fact, if the point of the style did not touch the bottom at any time the record sound would still be produced and would be improved, because of the elimination of the extraneous disturbing vibrations due to the grinding action.

As the style does not tightly fit the record groove, but is thrown from side to side therein, by the sinuous side walls thereof, it follows that the point of the style should leave a track in the bottom of the groove, namely, on that portion thereof which performs the grinding action. Moreover, this track would not be in the centre of the groove but would meander, as it were, slightly nearer to one side of the groove than the other, alternately. This is illustrated in "Defendants' Exhibit, No. 30" which shows the plan view of a gramophone record groove. Fig. 1 shows the groove before use and Fig. 2 shows the same groove with the track of the style in the bottom, illustrating the fact that the style does not fit tightly between the two walls of the groove but is free to move from one side of the groove to the other, though at all times nearly filling it. The irregularity of this track is due to the fact that when one of the walls in its rapid movement in the direction of the arrow, strikes the style, the latter will be nearer that wall than the other. The impact will cause the style to be forcibly thrown towards the other wall and its movements in that direction will continue until it comes into contact with the said wall and a similar action will be had upon the style, only in the opposite direction. At these points of impact, the track of the style will be found nearer to the wall producing the impact than to the other wall. In this manner the track is caused to meander regularly and in accordance with elementary mechanical principles, from one side to the other of the medial line of the groove. This also explains why the bottom of the groove performs no function in the reproduction, and it, moreover shows that there is no accurate tracking of any medial line of a groove such as is essential and is the essence of the invention of the universal

joint for the reproducer of the Bell and Tainter patent in suit.

"Defendant's Exhibit, No. 31" shows a drawing of an experimental gramophone reproducer.

Adjourned until Saturday, Feb. 23, 1901, at 10 A. M.

PHILADELPHIA, February 23, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of witness R. M. HUNTER resumed.

(Mr. Hunter continues his answer to Q. 12.)

Whether or not the bottom of the groove performs any function in the act of reproducing the sounds is readily demonstrated by supporting the reproducer so that the style cannot touch the bottom, and yet its point be permitted to be operated upon by the side walls. I have so operated the instrument and find that the statements above made, namely, that the bottom of the groove does not perform any function in the reproduction is a fact. The manner of ascertaining this is illustrated in "Defendants' Exhibit No. 31," which shows the reproducer with its style and gramophone groove on a very enlarged scale. The reproducer head is provided with what may be termed an experimental shoe. This drawing is marked with descriptive words corresponding to the different portions of the instrument. The construction of the instrument, other than the experimental shoe, is identical with the "Complainants' Exhibit Defendants' Machine." To such apparatus the brass shoe was added to sustain the reproducer head and style upon the upper surface of the record tablet, and so as to sustain the style clear of the bottom in a floating position adapted only to be acted upon by the side walls. In the operation of the apparatus it was physically impossible for the point of the style to rest upon the bottom, and yet the reproduction of the sound was the same as without the shoe, and when the style was used in its natural manner in the gramophone instrument.

Considering the defendants' apparatus, it will be seen that the reproducer, while mounted upon an arm, in a rigid manner, which arm is long and at its outer end has a universal mounting with the main frame of the machine, is not adapted to automatically adjust itself so as to bring the style to bear its pressure, yieldingly or otherwise, upon the "record," the style does bear upon the bottom of the groove by gravity, at least at the beginning of its use, that is to say, the weight of the reproducer and of the arm, upon which it is rigidly mounted, introduces this action of gravity just as it did in the early Edison machines of English Patent, 1644. However, the bottom of the groove not being the "record" in the gramophone, and not operating upon the style to vibrate the same, it cannot be said that the style bears upon the record. We have also seen, by reference to Defendants' Exhibits Nos. 24 and 26, that the successive gramophone record grooves, or successive spirals longitudinally of the same groove are separated from each other by wide, horizontal, blank spaces or "lands;" and it is quite clear that if the reproducer is placed upon the tablet so that the style happens to become upon one of these lands between the adjacent grooves, there is nothing in the apparatus that will induce the style to gravitate to the bottom of the groove. It would remain upon the lands indefinitely and would never get into the groove at all if the groove were not mechanically brought to it. Of course if the groove is brought to the style then the style will drop into the groove. However, when the defendants' machine is used in the ordinary way for reproduction the arm which supports the reproducer is swung around by the operator until the style is somewhere above a groove, and he then deliberately moves the arm which supports the head until he can insert the style point in the groove. That it is in the groove is readily ascertainable because the groove is so deep and the side walls so abrupt that there is no question as to when the style is in the groove. Furthermore, the record tablet is so hard and indestructible that there is no danger of injuring the

tablet by any carelessness in introducing the style into the groove or due to any lateral pressure upon it. After the style has been inserted in the groove the machine is started, that is to say the tablet is rotated. Under these conditions there certainly is no automatic adjustment of the style to the record or of the style to the groove, nor can it be said that the style gravitates to the bottom of the groove since it is placed there positively and cannot be placed anywhere else, unless it would be upon the lands, in which case it would not gravitate any way. It is thus seen that the essential features of the operation of the style of the complainants' patent in the claims under consideration are entirely wanting in the defendants' machine. Assuming that in starting the machine, that is the rotation of the tablet, was begun before the style was inserted in the groove, the operator would then swing the reproducer to the position desired and then lower it gently until the style is in operative position on the bottom of the groove. The style will either enter directly into a groove or it may touch upon one of the lands, but in this case, owing to the rapid movement of the record under the style, the latter will be placed in the groove before the operator's hand is removed from the reproducer head. This is the natural result, for it is not to be supposed that the operator would run the risk of injuring the tablet or the style, or possibly the reproducer itself, by merely carelessly dropping the reproducer and arm, and letting the style strike with force upon the moving tablet. Even in that case and under such abnormal conditions, if the style did not enter the groove in the first instance, and rested upon the lands, the groove would be quickly brought directly under the style, and the latter, under the heavy pressure exerted by the weight of the parts, would cause it to quickly drop to the bottom of the groove, and without practically passing over the record, and certainly without pressing upon the record, which is formed in the steep side walls. In any event, the style does not adjust itself to the groove, as the groove is adjusted to the style, and, under the circumstances, there can be no automatic adjust-

ment of the style down sloping side walls so as to gravitate to the bottom of the groove and finally rest upon the record. It does not do any of these things and there is no requirement or necessity for it doing any of these things.

Now, as the operation continues the style with its reproducer head, and with the arm that is rigidly attached to it, and supports it in such a position that its diaphragm is at right angles to the surface of the tablet, are all gradually moved across the tablet, the style always remaining in the groove and the latter propelling the style and connecting parts completely across the grooved portion of the tablet in opposition to the inertia exerted by the heavy weight of the reproducer arm, and the reproducer and the large horn attached, to the reproducer. This is only possible in the gramophone because of the great depth of the groove and the excessive steepness of the sides, and especially from the fact that the extent of the down pressure of the style against the tablet is unimportant in the process of reproduction, and consequently, permits the introduction of a heavy pressure sufficient to prevent the possibility of the style working out of the groove. This same pressure, if applied to the record tablet of the complainants' patent in suit, or even to the most improved record used by the gramophone, would completely destroy the record by tearing and gouging it out. The grooves, therefore, in the gramophone, the defendants' machine, has not only the function of vibrating the style by the lateral sinuosities of the side walls, but also to feed the style across the tablet from one end of the spiral groove to the other, by virtue of these same side walls coupled with the introduction of a heavy pressure on the style and the supporting surface either on the bottom of the groove or upper surface of the tablet which sustained this weight and prevent its direction application to the record in the side walls. This is necessary, because, as I have before pointed out, the style is thrown from one side wall to the other, and, consequently, it only intermittently rests against each of the side walls. There are times when it does not touch either side wall, so that in its operation it does not

continuously follow the sound record or permanently adjust itself upon the record in the sense in which those terms are applied to the Bell and Tainter apparatus. As a matter of fact, in the gramophone, the style is jerked or thrown by impact with one side wall across the open space of the groove until it strikes the opposing face of the other side wall further along in the groove, it taking an oblique course through the groove owing to the fact that the groove is rapidly fed under it during this lateral movement imparted to the style by the impact. This movement would be indicated in "Defendants' Exhibit, No. 30," by the style track between the points A and B, an examination of which will indicate that the track of the style is diagonally across the groove, and, at the intermediate portions, namely, between A and B, the style is out of contact with both side walls, and, consequently, out of contact with the "record." As I have before pointed out, the extreme point of the style is rapidly ground off, so that, as a matter of fact, the style point soon fails to apply any material pressure to the bottom of the groove, the weight being sustained mainly by the shoulder or ledges which operate upon the upper surface of the tablet plate, and, consequently, the style point could not bear upon the record. There is no similarity in the operation to that called for by the mechanism and by the description in the complainants' patent.

Claims 19 to 23 of the Bell and Tainter, and which I have heretofore considered, all contemplate the combination of the style and reproducer head, with a sound record in which the record proper is at the bottom of a groove, the mounting for the style or reproducer itself being such as to cause it to automatically adjust itself to the record, and to seek the bottom of the groove and the proper position or place upon the record; and since defendants' machine does not embody any such construction, I cannot see how it is possible for the invention of these claims 19 to 23 to be embodied in the structure of the defendants' machine. I have pointed out that Claims 19 and 22 are specifically directed to the loose mounting of the style, that is to say, its attachment to the

reproducer frame by the soft rubber diaphragm, whereby it may have capacity "to move laterally and there adjust itself automatically to the sound record," and this is a construction which is absolutely wanting in the reproducer head and style of the defendants' machine. There is absolutely nothing similar to it. The remaining claims, 20, 21, and 23, requiring, as they do, the adjustable support of the reproducer, it is necessary to more fully consider these claims.

Even if we were to assume that claims 20, 21 and 23 are to be so broadly construed as to comprehend generically, any character of universal joint or support for the reproducer, we would still fail to find in the defendants' machine the combinations called for by these claims, because said claims introduce the element of a record, and to make their structures operative, with such a record, namely, a vertically undulating one, which is the only record disclosed in the complainants' patent, it is necessary that the functions of the parts specified in the claims shall operate in a manner which is contrary to the functions in the parts of the defendants' machine, and as the defendants' machine is incapable of performing the functions attributed to the alleged corresponding parts of the complainants' patent, it follows that the structures are not identical and are not mechanical equivalents, even though expansive and general terms be applied in describing both apparatuses to give them a colorable appearance of being similar. If such a generic construction is to be given to Claims 20, 21 and 23, of the complainants' patent then they are fully anticipated by the prior art, and particularly by the Edison English patent, 1644, and the illustration in "Defendants' Exhibit, 21" which show vertically undulating record in spiral form combined with a reproducer attached to the free end of a supporting arm and which arm is jointed to the main frame of the machine on a universal joint so that the reproducer is free to swing both vertically and horizontally; and it is only when these claims are given an abnormal understanding, a scope which is totally inconsistent with the described function and operation as I have pointed it out,

and so as to include under their terms the structures of the prior art that it is possible to include under said claims, or within their terms, the structures of the gramophone, namely, the defendants' machine.

According to Mr. Cameron (X Q. 246) it is immaterial to Claims 19 and 20 whether a record is understood in the claims or not. In answer to X Q. 243, he seemed to think that a record was a necessary part of Claim 21, but in answer to X Q. 251, he retracts this as follows :

"A. I should construe claim 21 as defining any reproducer which is mounted on a universal joint and acting in conjunction with means capable of holding it against a record by yielding pressure, without regard as to whether such record actually were present or not ; that is, in my opinion, a machine for reproducing sounds which had a universally mounted reproducer which reproducer had means for holding it yieldingly against a record, the whole being so positioned that if the record were present it could operate as a reproducer in conjunction with such record, such a machine even in the absence of a record, would infringe claim 21."

A universally jointed reproducer is therefore not sufficient to come under the terms of this claim, according to Mr. Cameron, but the universal joint must be such, or it must be "acting in conjunction with means" so as to make it possible for the reproducer to bear against the record (the undulating part), if such were present, by yielding pressure. The means which acts in conjunction with the universally jointed reproducer to create the yielding pressure is the weight of the reproducer, partly counteracted by the elasticity of the section of rubber tubing. Of course if the weight of the reproducer counteracted by the weight of the elasticity of the section of soft rubber tubing as is understood in this claim, there could be no infringement, as the defendants' machine has nothing to counteract the weight of the reproducer. To be consistent then, Mr. Cameron must assume that the weight of the reproducer alone would serve the same purpose so far as claim 21 is concerned. If this is really the scope of the claim,

then it certainly is anticipated in "Edison's English Patent, Figs. 1 to 10," because, in that patent, we certainly would have a reproducer held upon free end of an arm which is in turn supported on the main frame by a universal joint, 5, 6. It is also unquestionable that the weight of the reproducer and its supporting arm will bring the reproducer down positively, upon the record in the groove, and will cause it to be held "against a record by yielding pressure" as defined by Mr. Cameron, as the requirements of Claim 21. But, in addition to the weight of the reproducer, in the Edison patent, there is a delicate spring arm, e^2 , which extends radically across the diaphragm and which supports the reproducer style, and this is further back between it and the diaphragm by a small section of rubber tubing; so that as the arm with the reproducer comes down by gravity toward the tablet, it is arrested by the reproducer style coming in contact with the bottom of the record groove and is supported thereupon under the elasticity of the metal spring and the section of rubber tube, thereby holding the reproducer against the record by the weight of the reproducer partly counteracted by the elasticity of the spring and short section of rubber tubing. We have, therefore, in this case, not only a reproducer which is mounted on a positive mechanical universal joint, such as used in the defendants' machine, but this reproducer is also acting in conjunction with means capable of holding it against the record by yielding pressure, and thereby meeting all of the demands for Claim 21 prescribed by Mr. Cameron. Not only does it happen that in this Edison machine the yielding pressure is produced by the weight of the reproducer and its arm, partly counteracted by the elasticity of the spring, but the reproducer is used in conjunction with a record tablet having a vertically undulating record in the bottom of the groove, and which groove has sloping side walls. For this reason it is also clear that Claim 23, under Mr. Cameron's interpretation of it, is fairly and squarely anticipated by the Edison English Patent, 1644.

I have very fully pointed out, and especially in conjunction with Defendants' Exhibit No. 39, that my understanding of the claims of the complainants' patent did not warrant any such understanding as that given to them by Mr. Cameron, and necessarily so if they are to be construed sufficiently broad to include the defendants' machine; but, on the other hand, Claims 19 and 22 did not contemplate the necessity of a universal or even a laterally movable joint for the reproducer, but related to the construction in which the lateral adjustment of the style was secured by its own very flexible mounting to the soft rubber diaphragm; and that Claims 20, 21 and 23 involved the introduction immediately adjacent to the reproducer, and between it and the supporting arm (whether said arm is hinged only on a transverse joint, or both upon a transverse and vertical joint, namely, a universal joint) as graphically illustrated in "Exhibit No. 39," whereby the exceedingly delicate lateral adjustment of the reproducer might be had upon the arm to enable the style, when not flexibly mounted (see Fig. 8), to automatically adjust itself within the purview of a groove or thereabout, to compensate for the particular irregularities in the record groove specified in complainants' patent, and more fully pointed out in my previous testimony. This understanding is necessary to save these claims from anticipation, and it is not a case of giving them a forced construction for the purpose of saving them, but it is simply construing them properly and in accordance with common sense based upon the actual disclosures in the patent itself. The claims should not be read as if they were for abstract constructions, but should be analyzed as relating to a part of the structure of the organized machine, illustrated and described in the patent itself, and which is referred to in the claims by the words "substantially as described." It is further proper that these claims should be construed as being for a part of the machine shown and described, as an additional and essential element, and not as an alternative element contemplating the complete dispensing with of the external mechanical feed mechanism when there

is not a hint of any kind that such a thing was possible. If the claims are construed as I have understood them, then the defendants' machine does not embody the structure required by the claim.

Claim 23 requires a specific form of record, namely, one in which the sound record being vertically undulating, forms an irregular groove, that is irregular in depth, and this is provided with sloping walls. The record is at the bottom and is the active agent in producing the vibrations, and the sloping walls are the means for guiding the style to the record. This character of record tablet is combined with a reproducer having a style for rubbing over said record, and said reproducer is mounted on a universal joint. In the first place, the defendants' machine has no record tablet of that character, as I have pointed out, and it has no style which constantly rubs over any record, and it has no sloping walls for guiding the style upon and making it track upon a record against which the style is pressed, so that under no conditions is the subject matter of Claim 23 embodied in defendants' machine; the language of the claim itself precludes such a finding. While on this matter, I would point out that Claims 21 and 23 speak directly of the *reproducer* being mounted on the universal joint, and this does not mean the reproducer rigidly mounted to the end of the carrying arm and the arm universally mounted on the main frame at the distant end, and is employed in the defendant's machine, for such an understanding would also make it a different construction from that shown and described in the patent, and would be exactly for what is shown in Edison's English Patent, 1644. I would also point out that in Claim 21 it is stated that the reproducer itself is mounted on a universal joint, and it is by virtue of this universal joint that the said reproducer is held against the record by yielding pressure, showing that the universal joint is designed to be close up to the reproducer itself, which is in accordance with the illustration in the patent, the said understanding in no way modifying or changing the employment of the old and well known hinge arm for

carrying the reproducer or the external mechanical feeding devices, employed in the machines of the class described in the Bell and Tainter Patent, in which the invention is employed. This understanding is absolutely consistent with the Bell and Tainter invention, but under it there can be no possible infringement of the claims by the defendants' machine.

Recess.

Q: 13. You have pointed out that in the machine of the Bell and Tainter Patent in suit the freedom of lateral movement of the reproducer style is very limited, and is utilized only to the extent of the purview or width of a record groove. On the other hand, Mr. Cameron, in his testimony, with which you are familiar, says in effect that the patent gives to the style a wide range of freedom of lateral movement, and that a much wider range of lateral movement than the width of a record groove is actually utilized in the machines which are in commercial use, and which embody the inventions of the patent. Will you please state whether in your opinion Mr. Cameron correctly interprets the patent in suit in this respect, and whether he correctly states the performance of the commercial gramophone, and give your reasons for the opinion you may express?

A. Mr. Cameron, in my opinion, incorrectly interprets the patent in suit and also incorrectly states the performance of the alleged patented improvements which are supposed to be embodied in the commercial gramophone.

Mr. Cameron's opinion is based necessarily upon the specification of the patent and upon its drawings, and upon the evidence showing the necessity for the automatic adjustment of the style. From these he deduces the capacity of the invention of the Bell and Tainter patent to be one embodying a wide range of freedom of lateral movement or adjustment of the style. Examining Mr. Cameron's testimony I find that he bases his opinion largely, if not wholly, upon the following statements: He quotes from the patent, page 1, lines 76 to 83, as follows:

"The invention consists, thirdly, in cutting or engraving the record in the form of a groove with sloping walls, the sound-waves being represented by elevations and depressions at the bottom of the groove or otherwise. The advantage of this form of record is that it forms an efficient guide to the reproducing style."

In commenting upon this paragraph he emphasizes that part of it which ascribes to the groove with sloping walls the particular advantage that it "forms an efficient guide to the reproducing style." He next quotes from the specification, page 1, lines 84, etc.

"The invention consists, fourthly, in loosely mounting the reproducing style so that it can readily be guided by the record. Preferably the reproducing style, or rather, what may be called the "head" of the reproducing instrument, is mounted on a universal joint, and the style is pressed against the record by the yielding pressure of a spring or weight. Practically in the instrument made by us the pressure is due to the weight of the instrument, modified by the elasticity of a section of soft rubber tube, which supports the same and constitutes a universal joint; but evidently there are many devices which can be used to mount the reproducer so that it is free to follow the sound record or phonogram, and which, therefore, would be within the spirit of the invention. The reproducing style, mounted as just explained, is specially adapted for use in connection with a record in the form of a groove with sloping walls, and this combination is specially claimed; but it may also be usefully employed in connection with other forms of record.
* * *

Upon this passage of the specification Mr. Cameron freely comments, and in conclusion observes:

"The object of thus loosely mounting the reproducer is not only to enable it to adjust itself to the irregularities of construction, which I have just mentioned, but *is also for the purpose of enabling the reproducer to be guided and moved by the record.*"

The italics are Mr. Cameron's. I would call particular

attention to the words "and moved," which function he introduces as the function of the record and permitted by the universal joint. There is absolutely no warrant for any such understanding of the language quoted from the patent or from the specification of the patent as an entirety. Mr. Cameron implies that the reproducer is moved by the record, *i. e.* fed by the record, as distinguished from being guided, thus introducing into the patent the idea of dispensing entirely with the external mechanical feeding mechanism of the machine. As I have before pointed out, the patent does not warrant any such understanding, and Mr. Cameron does not show where in the patent such an idea can be consistently found. Claims 19, 20 and 22 speak of the capacity of movement as being one to "adjust" the style to the record. Claim 22 states that the style is free "to move laterally" to adjust itself to the groove. Claim 19 states that the style is free "to move laterally and thereby adjust itself automatically," and Claim 20 states that the reproducer is loosely mounted so that the style "is capable of a lateral movement, and may, in consequence, thereof adjust itself." The words "move" and "movement" in these claims, as I have before pointed out, have nothing whatever to do with the idea of feeding the reproducer from groove to groove rectilinearly across the record tablet. As a matter of fact the word "move" in Claims 19 and 22 is answered by the loose mounting of the style itself on the soft rubber diaphragm, and it is quite evident that this capacity to move is practically under those conditions limited to the purview of a groove. There is not the remotest suggestion in the patent to a distinction between the words "adjusted" and "move," and, certainly, there is nothing in the patent which can be attributed to the word "move" as implying the transverse feeding of the reproducer as an entirety across the record tablet.

Mr. Cameron next quotes from page 4, lines 68-84, as follows:

"There exists always a liability to disarrangement in some part of the machine, either in the recorder or the

support therefor, or the recording tablet or its support, or if there be no disarrangement it would be difficult to insure that the reproducing-style should touch the record precisely at the proper point if the reproducer is held rigidly. Difficulties on these accounts are avoided by the loose or flexible mounting of the reproducer, the style automatically adjusting itself to the proper place on the record. It will be seen that the reproducer is mounted on a universal joint, so that it can move in any direction. The movement parallel with the face of the tablet, would, however, by itself, allow the style to follow and adjust itself to the record to a useful extent."

And after quoting the above, Mr. Cameron remarks:

"As is pointed out in the paragraph of the specification, which I have heretofore quoted, this loosely mounted reproducer is specially effective when used in connection with a record groove having sloping walls, because this form of groove is an efficient guide *to carry the reproducing style along over the record.*"

Here again Mr. Cameron seeks to convey the idea that the function of the record groove (because it has sloping walls) is to carry the style along; that is to say, move the style or feed it transversely across the record, and the whole series of parallel grooves formed therein. I have at great length pointed out that such an understanding is unwarranted by any language found in the patent, and that it was absolutely inconsistent with what was illustrated. This idea of Mr. Cameron's must have been created in his own mind for the purpose of including, under the terms of the claims of the patent in suit, the defendants' structure. A little further on in his testimony, when summarizing the advantages of a universally jointed reproducer, he states the following advantage:

(3) "It enables the reproducer to be guided and carried along by the sound-groove, so that the reproducer is free to follow the same and move across the record in a line parallel with the surface thereof."

This is probably the first time Mr. Cameron clearly asserts that the universal joint in the complainants' patent is

for the purpose of feeding the reproducer across the record tablet under the action of the sound groove. He thus asserts that the sound groove *propels* the reproducer from one end of the record to the other, thereby dispensing entirely with the use of external mechanical feeding devices. He has ingeniously injected into his testimony from time to time statements which were to transform "adjusted" into "moved," "moved" into carry * * * along over the record" and finally, the latter statement into the elaborated statement quoted immediately above, in which he injects plainly the idea that the reproducer is not only guided by the sound groove, but is positively "carried along" by it, and not only that it is free to follow the groove, but that it is adapted to "move across the record." This understanding is absolutely inconsistent with any idea suggested in the patent, and is wholly unwarranted from the nature of the invention and the necessities which were the cause of its creation. The invention was designed to overcome a difficulty which existed in an external mechanical feed machine of the type shown in the Bell and Tainter patent, and also in the prior Edison patents, though to perhaps a lesser degree, and not to the removal of a material part of those prior mechanisms by dispensing entirely with the external mechanical feeding mechanism. That my understanding is correct, is evidenced by the fact that if the causes of the defects were to be eliminated, then the statement at the beginning of column 2, page 4, of the specification, would become an absurdity, and instead of providing means to overcome the defects which are stated to be peculiar to the class of machine described and shown in the complainants' patent, the patentee would have plainly stated that the causes of these defects, as well as the defects themselves, were eliminated by directly relying upon the record groove and the adjustability of the reproducer head as the sole means for feeding the reproducer across the record. However, they make no such statement, and the patent itself does

not imply any such understanding, but, on the other hand, it very fully and clearly shows that the presence of the defects are there in the complainants' machine, and would continue to exert their objectionable results if it were not for the introduction of this particular small adjustability of the reproducer and style to enable the latter to adjust itself laterally within the purview of a groove, to seek the bottom or active part of the groove and continue to follow the same during the mechanical external feeding of the machine, namely, of the reproducer relatively across the record tablet. Any views expressed by Mr. Cameron contrary to this are wholly unwarranted, and were it necessary that the claims did have such an understanding, then they would be invalidated by the prior art.

Evidence that Bell and Tainter never had any such idea of their invention as that read into the patent by Mr. Cameron, is further evidenced by the patent itself, in that it clearly shows a complex system of gearing for mechanically propelling or feeding the record tablet past the style and reproducer, and it would be preposterous to charge them with the absurdity and folly of developing and introducing into their machine a complex external piece of mechanism for feeding the record tablet across the reproducer laterally, if they had, as Mr. Cameron ingeniously attempts to show that they had, an efficient means within the machine itself for feeding the reproducer across the record by the record itself. Messrs. Bell and Tainter are not the character of men to be charged with such stupidity. As specific external feed mechanism is shown in the patent and minutely described therein, and was always used in the prior art up to and after the date of the complainants' patent, and continues to be used not only by Edison but by the Graphophone Company, the complainants, there is no room for any assumption that the style was to be fed across the record tablet either by the record itself or any other way.

Adjourned until Monday, Feb. 25, 1901, at 11 A. M.

PHILADELPHIA, February 25, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of witness, R. M. HUNTER, resumed :

(Witness continues his answer to Q. 13.)

Any new idea which Mr. Cameron can have which warrants him in assuming that Bell and Tainter proposed to rely upon the record groove and the universal jointing of the reproducer, as a means of dispensing with the external mechanical feed, to have any weight, must at least be based upon some language in the specification. I have shown those portions of the specification upon which he seems to rely for his understanding do not warrant the broad contentions which he makes. For instance, he construes the statements "so that it is free to follow the sound record" and "the reproducer is mounted on a universal joint, so that it can move in any direction" as warrant for the statement that the groove "is an efficient guide to carry the reproducer along over the record," and "so that the reproducer is free to follow the same and move across the record." There is no warrant for any such understanding as the words "over" and "across" are injected to give to the language of the patent an entirely different meaning. The adjust, as I have before pointed out, is only necessary within the purview of a groove to enable the style to follow or track the said groove when, by the rotation of the tablet and the rectilinear adjustment by the external feeding mechanism, the spiral groove is caused to be fed longitudinally and maintained practically under the style at all times, so that at no time is it necessary for the style or the reproducer head to have an adjustment of more than one one-hundredth part of an inch to secure the most perfect results.

The "guiding" action referred to in the patent is simply the action of the sloping walls of the groove upon a loosely mounted style, whether of the style itself or of the reproducer head, whereby the style will ride down these walls so as to come to rest at the bottom or record portion of the groove. The entire possible adjustment under these conditions, in a

commercial machine, is about one-hundredth of an inch. It means nothing more, it has no occasion to mean anything more, and the very construction of the machine illustrated in the patent precludes, under any reasonable understanding, that the patentees contemplated anything more. If this view is correct, then the style is not moved *by* the record groove, but is allowed to *move in* the record groove, that is to say, it is moved by gravity, and by this external influence it is simply permitted to "gravitate to the bottom of the groove." So also when the patent speaks of the ability of the reproducer, because of its universally jointed mounting, to "follow the record," it means nothing more than that because of this capacity to move in the record groove, and seek the bottom, it is enabled to maintain that position when the record is moved longitudinally under it, and it thereby follows the record to maintain its position thereon in the bottom of the groove. This contemplates that the groove shall be mechanically brought to the reproducer style and fed at all times under the style in approximately the right position, any displacement of the record to the style from any cause being, as I have pointed out, limited to substantially the width of a groove, namely, one one-hundredth of an inch.

That the idea of mere adjustment within the purview of a groove was all that was contemplated by the invention of the patent in suit is, I think, excellently shown by reference to the Leeds case before referred to. In that case Edison's machines employed a mechanical external feed in addition to the adjustment of the reproducer style, and in referring to the invention of the complainants' patent, namely, the Bell and Tainter Patent here involved, Mr. Arthur S. Browne, the expert for the Graphophone Company, stated :

"The instruments which have been put upon the market by the complainant herein, and which embody the essential features of the patent in suit, are commercially known as "graphophones" * * * In the actual machines of the complainants the recording tablet rotates and the relative longitudinal movement between

the recording tablet and the recording cutting style is secured by the longitudinal movement of the recording style."

This introduces the external mechanical feeding features, the reproducer being fed mechanically over the record in the same manner, namely, by a screw feed. Mr. Browne points out that in such a machine, when employing the reproducer of the Bell and Tainter patent, the "essential features" of the patent are embodied, and comments upon these features as follows :

"One of the most important results of the freely mounted reproducer is that it is enabled to always maintain register with or 'track' the record groove irrespective of any accidental irregularities in the groove, or lack of symmetry in the recording tablet. - Owing to its free mounting, or universal connection, the reproducer is not only capable of following the irregularities of the bottom of the sound groove, by virtue of which the sounds are reproduced, but it is also capable of lateral movement to accommodate any accidental lateral deflection in the sound groove, and is also capable of bodily up and down movement to accommodate itself to any lack of symmetry in the recording tablet. Another important result is that the reproducing style or point readily and automatically finds its way into the sound groove at the start without attention on the part of the user. * * * The sloping side walls of the sound groove have an important co-operation with the freely mounted reproducing point, since they automatically guide the point to the bottom of the sound groove, the irregularities of which bottom constitute the active sound reproducing agents." (Leeds Record, p. 21.)

This statement shows that the complainants in that case only contended that the universal mounting was to adapt the style to adjust itself to the bottom of the groove and follow the record in the bottom, said adjustment being within the purview of a groove. They did not contend that the said adaptability of the style to the groove embodied in any sense the feeding of the style or reproducer by the grooves them-

selves across the record and the entire series of spirals, and thereby dispense entirely with the external mechanical feed. No such idea as this was contended for. It is clear from Mr. Browne's testimony that the "guiding" action relates to the tendency of the sloping walls to "automatically guide the point to the bottom of the sound groove," and that the idea of "following" the record is the possibility of insuring the style to constantly bear upon the elevations and depressions in the bottom of the groove, his language being "following the irregularities of the bottom of the sound groove, by virtue of which the sounds are produced." This idea of following a groove is correct and does not contemplate in any sense the idea of feeding the reproducer and its arm "across" the record tablet, the latter function being performed wholly by the external mechanical feeding device.

Mr. Tainter, one of the patentees of the Bell and Tainter patent, in his patent 341,288, also here in suit, throws some light upon this question, and undoubtedly substantiates my understanding. That patent is stated to be for an improvement upon the Bell and Tainter patent (then an application). In this patent 341,288, Mr. Tainter states:

"Seventeenth. The record is not always perfectly true or straight—that is to say, the record style not only moves lengthwise or at right angles to the recording surface, but has or is liable to have a side vibration, which, of course, is recorded in the tablet. These side vibrations produce errors in reproducing, unless means are provided for enabling the reproducing style to move sidewise also. The mounting of a reproducer on a universal joint obviates the difficulty to a certain extent, but not altogether satisfactorily, since the inertia due to the large mass of the reproducer is too great for it to respond as quickly as required. The difficulty is in the present invention overcome much more thoroughly by supporting the reproducing style so that it, or at least the end in contact with the record, can move sidewise independently of the diaphragm or other device upon which it impresses the vibrations. This freedom to move sidewise can be secured by allowing the style to rock upon the

end in contact with the diaphragm or other device behind, or by making a style in whole or in part of flexible material, or by mounting it on a flexible support, the flexibility, of course, being in the required direction (page 2, line 134 to p. 3, l. 27.)

From this paragraph, sworn to by Mr. Tainter, one of the parties to the Bell and Tainter patent, it is evident that the universal mounting of the entire reproducer was considered objectionable and that he preferred to secure the same results by simply making the style connection more flexible. It will be noted that in the Bell and Tainter patent the idea of loosely mounting the style in place of the reproducer as a whole is clearly shown in Figs. 10 and 20, and in this Patent 341,288, Tainter comes back to this idea, as being all that is necessary for securing this adjustment which will enable the style to adjust itself to the bottom of the groove and follow the record. But here, as in his previous patent, and also his other patent 375,579 in suit, he retains and relies upon the external mechanical feeding devices as the means and only means of moving the record tablet across the style or the style across the record tablet during the time the style is maintained its adjustment in and following the bottom or active part of the groove while the latter is fed longitudinally under the style. Mr. Tainter, therefore, by his own statements, refutes the present contentions of Mr. Cameron regarding the invention here in controversy.

Mr. Tainter further, in speaking of the reproducer, in his said patent 341,288, says :

“It is then released, and the reproducer, falling forward, brings the style into contact with the record. Preferably the grooves are so close together that the ridge between them tapers to an edge on top, so that, no matter where the reproducer may be placed, the style will enter a groove, and being free to move sideways will, owing to the sloping sides of the groove, penetrate to the bottom thereof under the action of gravity, the fly-wheel being turned at about the speed used in recording the reproducer will follow the spiral groove cut by the

reproducer, and will be acted upon by the inequalities or irregularities of the record, (page 8, lines 83-97)."

This statement is interesting, first, because it clearly describes the whole function of the adjustment and following of the style to the groove, or more particularly, to the bottom thereof, showing that said adjustment is limited to the purview of a groove; secondly, in that it shows that the external mechanical feeding mechanism is relied upon to produce the transverse feeding; and, thirdly, that it establishes the character of cross section of the grooves and substantiates the correctness of the graphophone grooves shown in "Defendants' Exhibit, No. 26," more particularly in the fact that the grooves are "so close together that the ridge between them tapers to an edge on top."

Mr. Tainter also gives a further reason for this slight capacity for lateral adjustment of the style, in a machine of the class shown in that patent, and also all machines where there is an external mechanical feed mechanism, and, in this connection, says:

" * * * A slip between the wheels causes the reproducer to be fed faster or slower than the spiral on the tablet permits the style to advance. As a general thing there is more slip in recording than in reproducing, and consequently the reproducer outruns the style slightly. The style should be given enough side play to compensate for this difference in speed; but if not given the only difficulty is that the style will at length slip across the ridge between the grooves, and thus escape the action of a portion of the record, so that it may be necessary to bring back the reproducer by reversing the feed, (page 9, lines 40-54).

Here again Mr. Tainter speaks of the ridges between the grooves, and also very clearly indicates the external mechanical feeding as being an essential part of the machine, showing that if the slip produced a slight advance of the reproducer carrier, the adjustment of the style would adjust itself to the groove, so as not to compel the style to be

dragged over the ridge. This explanation by Mr. Tainter goes to show very clearly that there is no intention whatever of causing the style and groove to feed the reproducer, but, on the other hand, that it should only have this flexibility or adjustability which will prevent the external mechanical feeding mechanism from displacing the style, the capacity for such adjustment being exerted simply over the approximate distance equal to the width of a groove. Mr. Tainter has here, in his patent 341,288, very clearly shown the real intended purpose and the extent of the invention found in the universal support of the reproducer contained in the Bell and Tainter patent (in which patent 341,288 was an improvement), and he certainly at that time, namely, the date of the patents, May 4, 1886, clearly refutes the present contentions of Mr. Cameron in his endeavor to enlarge the scope of the claims of the Bell and Tainter patent sufficiently to include the defendants' machine by introducing the idea of the record feeding the reproducer across the tablet solely by the co-action of the style with the groove, eliminating entirely the use and necessity of the external mechanical feeding mechanism.

The inability of the machine shown in the Bell and Tainter patent to feed the reproducer across the record tablet without the employment of the external mechanical feeding devices is clearly evident by an examination of the drawings. From the construction of the pivoted supporting arm and reproducer, it is evident that the small piece of rubber tubing cannot be soft and flexible beyond reasonable limits, because this piece of tubing must support the entire reproducer on the top of the arm, and, as the reproducer has considerable weight, that which has been stated as "too great for it to respond as quickly as required" by Mr. Tainter himself, it is evident that no very great freedom of movement can possibly be allowed or secured by a support for the reproducer in this manner. Ample adjustment, however, may be had with the small flexibility required to adjust the style to the extent of the width of a groove. I would further point out

that the location of this small section of rubber tubing is close up to the reproducer itself, and at the extreme end of the long supporting arm which is hinged to the main frame of the machine. This location of the rubber tubing, coupled with the fact that it must support the weight of the reproducer, shows that only a very slight possibility of adjustment would be possible, and this is in accord with the invention as I have explained my understanding of it. If under these conditions of construction the reproducer was required to have any movement beyond one of a very limited extent, a very appreciable force must be applied, but it requires no argument to show that there is no means capable of applying such a force, and if such a force were attempted to be applied by excessive pressure upon the record, the destruction of the record would unquestionably result. However, for the slight adjustment required by the patent, namely, one one-hundredth of an inch, or, possibly, a little more, would be fully given by the construction shown without injury to the record.

There is another point to be kept in mind. The rubber tube has of necessity a certain resiliency, a resistance to being bent. The patent says, when speaking of the pressure with which the reproducing style bears upon the record :

" Practically in the instruments made by us the pressure is due to the weight of the instrument, modified by the elasticity of a section of soft rubber tube, which supports the same and constitutes a universal joint.
* * * " (Page 1, lines 92, 96.)

The weight of the instrument, is, therefore, *modified* by the elasticity, that is to say, the resiliency of the soft rubber tube. As the weight is considerable, and not only will include the downward thrust due to the dead weight of the reproducer, but also the bending effort of the weight of the hinged arm and the reproducer, it follows that the free movement in a lateral direction of the style, permitted by such a universal joint as shown, must be exceedingly small. Small though it may be, it is amply sufficient for the purpose of the Bell and Tainter machine since the duty of transversely

feeding the reproducer across the record is placed upon the external feeding mechanism and not upon the record grooves acting upon the style of the reproducer. I am considering what the patent shows taken in connection with the description of the patent and the light thrown upon the mode of operation as found in Tainter's patent, 341,288, and the expert testimony in the Leeds case, and I am thoroughly convinced that there is nothing shown in the Bell and Tainter patent which will warrant for the universal joint, 32, anything more than the most minute lateral adjustment to fulfill all the necessary and reasonable requirements of the invention. The Bell and Tainter idea may be summed up as follows, namely: From the nature of the invention of the phonograph, defects in adjustment of the parts operating and operated upon caused by defective tablets, defective engraving of the record, displacement in adjusting record tablets upon the machine, and such like, necessitate a little looseness or free play between the style and the record groove and the provision of such looseness immediately at the reproducer. To secure this looseness, and yet not allow it to be excessive, and, at the same time to include elasticity to normally centralize the position of the reproducer style, they preferred to employ the small section of rubber tubing. In all machines more or less looseness occurs, in some cases more is desired than in others. When it is necessary, it is provided by engineers without the thought of making an invention. Bell and Tainter have provided this small looseness which they found desirable because of the presence of these defects in the record and its position, and yet they certainly introduced this slight looseness without any intention or desire of giving it any magnitude or capacity which would in the smallest way interfere with the proper operation of the external mechanical feeding devices, and certainly not with the idea of displacement. As a warrant of Mr. Cameron's introduction of the idea of the universal joint, permitting the reproducer to feed itself entirely across the record tablet, he points out that while the tablet is moved rectilinearly across the

style point by a screw and gearing, this mode of displacing the tablet is unsafe, and might possibly fail either temporarily or permanently, and, for that reason it is necessary to have the reproducer hinged on a universal joint, so as to have freedom sufficiently to enable it to be propelled across the engraved portion of the tablet. There is not the smallest suggestion of such a possibility or of such a use in the patent. It seems to me preposterous to assume that a mechanical feeding mechanism of the character shown in the patent could possibly fail to feed, and we certainly would not look to such a delicate suggestion as the shallow groove of the record tablet being called upon to feed the reproducer against the resiliency of the tubing which supports it, as a guard against inoperativeness of the machine from the first cause. The idea is too absurd to merit serious consideration. If the mechanical feeding mechanism should under any conditions fail to operate it would be high time to send the instrument into the workshop for repairs, for there appears to be no possibility of it failing to work unless it is permanently disabled. Such contentions on the part of Mr. Cameron only go to show to what extent he finds it necessary to go to discover some excuse for introducing into the patent a meaning sufficiently broad to include the defendants' machine.

Recess.

Mr. Cameron points out that if the feed screw of the Bell and Tainter machine fails to propel the tablet, reproduction of sound could not be obtained unless the style were free to be propelled across the tablet by the groove. This is true, but, because it is true, it is no ground for assuming that the machine was intentionally designed with two modes of feeding, and that when one failed the other one was to perform the function, yet that is what he would have us believe. He says that he used a commercial graphophone embodying the Bell and Tainter invention, experimentally for reproduction, and disengaged the feed screw from its nut, so that the style was not propelled across the tablet by the feed screw, and that he found, under such circumstances, that the style

was still propelled across the tablet to the extent of "*three grooves*." Bearing in mind that this was not in a machine having the details of construction as shown in the Bell and Tainter patent, but in a later improved machine, which should have incorporated these features of excessive capacity of adjustment which Mr. Cameron so freely introduces into the Bell and Tainter patent, even under this assumption, namely, that the machine did embody the ideas of the Bell and Tainter patent, the great freedom of which he speaks positively, is reduced in a practical machine to the minute extent of three one hundredths of an inch, and this under the careful operation of an expert who was seeking to secure the greatest possible adjustment. However, in that operation the freedom of movement was utilized under conditions which by no possibility could occur in the actual, normal and legitimate use of that graphophone machine, or in the Bell and Tainter invention. It was an abnormal and special operation of a special machine which may or may not have included in its construction the invention of the Bell and Tainter patent in suit. Even under these unnatural and forced conditions, the extent of freedom only amounted to three one hundredths of an inch, or the extent of three grooves out of a possible three hundred and twenty-five grooves on the record, or less than one one-hundredth of the adjustment that would have been necessary to have enabled the machine to have caused its reproducer to have fed itself transversely across the grooves of the record tablet to perform the ordinary and natural requirements of the defendants' machine. While Mr. Cameron claims to have been able to secure a lateral capacity of adjustment equal to less than one per cent. of the required feeding in the machine employed, Mr. Lyons, an expert in behalf of the National Gramophone Co. and Frank Seaman, in a suit brought by the American Graphophone Co. against those parties, in the Southern District of New York, testifies as follows:

"I have repeated the experiment to which Mr. Cameron referred in his testimony, a great number of

times, using the commercial gramophone, of which Mr. Cameron said that it embodies the Bell and Tainter invention. I did exactly what Mr. Cameron said that he did, namely, I disengaged the feed screw from the nut by which the reproducer head is normally propelled against the record; so that it could not be thus fed across any more, while the record cylinder still continued to be rotated. The result was that I obtained, by way of reproduction, an endless repetition of the sounds recorded upon *one* and sometimes upon *one and one-half* turns of the helical record. It was a succession of light sounds or shouts, that is to say, the same shouts were reproduced in succession.

"The behavior of the machine was as follows: The style was, owing to the universal joint of the reproducer head, propelled across the record tablet to the extent of one or one and one-half the width of a record groove. When it arrived at this extreme excursion, it immediately snapped back to its original position; it was then again fed forward to the extent of one or one and one-half turns of the helical record groove, and then snapped back to its original position; and so forth, in endless repetition. This means that the style had freedom of lateral movement to the extent of $\frac{3}{200}$ of an inch. Mr. Cameron says that he obtained double this amount of freedom of lateral movement, namely, $\frac{3}{100}$ of an inch. I can never obtain as much as this.

From this testimony of Mr. Joseph Lyons it appears that the possible lateral capacity for adjustment in the graphophone machine did not exceed one-half the per cent. of the extent of feeding which would have been necessary to have traversed the whole series of grooves on the cylinder to correspond to the normal operation of the defendants' machine. I would point out that while these machines may have had this capacity of three two-hundredths of an inch, or even three one-hundredths of an inch, when used abnormally, this would have only meant an intentional capacity of one one-hundredth of an inch, or the width of a groove in the normal operation of the Bell and Tainter machine, or of those graphophone machines, because to secure this proper operation

within the purview of one groove it would be common sense to make a little more play so as to be very sure of getting the adjustment equal to one groove. Besides, it would be a most expensive and difficult thing to get an adjustment equal to exactly one groove, and, as it should not be less, ordinary rules of economical manufacture would make it a little greater than was actually required. This is all that these experiments show beyond the fact that, to my mind, they corroborate the opinions which I have expressed as to the real invention set out and claimed in the Bell and Tainter patent in suit.

Before leaving this subject, I would again refer to the Tainter patent, 341,288, also here in suit, and point out that the style itself instead of the reproducer as a whole, as a universal mounting (just as in Figs. 10 and 20, of patent 341,214), and with this capacity for adjustment, with perhaps an extreme limit of the width of from one to two grooves, is stated to be an improvement upon the Bell and Tainter Patent 341,214, and specially designed to perform the function of the universally supported reproducer. This machine, shown in patent 341,288, I believe was the first practical machine given to the public and alleged to embody the Bell and Tainter inventions, and it evidenced the fact that for the successful operation of reproducing sounds under their inventions the capacity for lateral adjustment of the style was not required to extend over a distance of more than about the width of one groove.

Q. 14. You have made an elaborate examination of Claims 19 to 23 of patent 341,214 in suit, and have given, at great length, your reasons for your opinion that these claims, if construed to cover patentable subject matter, are not infringed by the defendants' devices. If you can give expression to some of the more salient considerations which shape your opinion in a brief manner, and without extensive or specific references to the patent, or to the prior state of the art, please do so.

A. Bell and Tainter produced a wax record tablet hav-

ing exceedingly fine grooves, approximating each one one-hundredths of an inch wide. The method of production requires that these grooves shall be very shallow and with walls so gently sloping that it is exceedingly difficult even if very largely magnified to perceive and appreciate the slope. The commercially efficient and only useful part of the groove for actually reproducing sounds, is the record at the bottom or centre of the groove. The grooves were so closely adjacent that they ran into each other at their sides to form intermediate ridges. The reproduction from such a record groove, was produced by external mechanical devices causing a relative feeding motion of the groove under the style of the reproducer, while, at the same time, the style had to be given a capacity of lateral adjustment to insure its following the exceedingly fine groove, and tracking the bottom or active portion thereof in which the vertically undulating record is formed. The capacity of adjustment was required to be approximately one one-hundredths of an inch so that the style might be so guided down the sloping side walls to the bottom of a groove, namely, the groove which happened to be nearest under the style when adjusting the record tablet to the machine or under the or by the normal operation of the external feeding mechanism. They provided this delicate capacity for adjustment of the style, namely, within the purview of a groove, in a machine employing a vertically undulating record having exceedingly fine grooves, and an external positive mechanical feeding device for reproducing the rectilinear relative movement between the record tablet and the reproducer and its style, whereby successive spirals were brought successively and approximately under the style. By the employment of a mechanical feeding mechanism the smallest possible lateral adjustment to the style was made necessary, and was all that was useful or desirable. Such a reproducer, operating with a record groove of the character mentioned, performed two functions. First—it enabled the style to slide down the gently sloping walls or gravitate to the exact bottom of the groove, namely, the position which it

should take to secure the best results of reproduction, in fact, the only satisfactory results.

Second.—The yielding pressed, universally mounted reproducer continued to keep the point of the style with a constant and uniform pressure continuously in contact with the vertical undulations at the bottom or middle portion of the groove, whereby it followed the record when the groove was moved longitudinally under it. This was absolutely necessary, for with a vertically undulating record it is not permissible that the style should at any time leave the face of the undulating record surface, because, in such case, there would be no reproduction.

In view of these conditions, there appears to be a combination between the engraved wax record of the character mentioned and the universally jointed and yielding pressed reproducer, in that, with a machine of the character disclosed in the complainants' patent, employing an external mechanical feed, the numerous defects or causes of displacement between the record groove and a mathematically and uniformly fed reproducer style, are overcome by the provision of this slight additional adjustment of the reproducer. The exceedingly shallow depth of the wax record of Bell and Tainter and the soft material of which it is composed, necessitates in the practical operation of the invention that there shall be a positive external mechanical feeding mechanism which shall remove all duty from the reproducer to feed itself across the record tablet, but leaving it the function of centering itself in the bottom of the groove and maintaining that position or following the centre of the groove while the latter is longitudinally fed under the style.

The Berliner sound record tablet having its record grooves produced primarily by an etching process, great relative depth is thereby secured, and, furthermore, there are no gently sloping side walls, these being very steep and terminating in a clearly defined bottom in which there is no irregularities or vertical undulations. In the making of the Berliner record groove, the cross section would be a mathematical

rectangle, if it were not for the peculiarities of the acid to eat slightly more rapidly at the upper edges of the groove and less rapidly at the lower part of the walls, giving to these parts a curvature. In any event, the walls are steep and the groove is very deep. The character of the groove is specially constructed to produce mechanical work in positively feeding the reproducer across the record, and the steep walls alone perform the function of imparting the vibrations to the diaphragm, and these are performed alternately, first, by one wall and then by the opposite wall, such operations being in an intermittent manner, while in the Bell and Tainter apparatus the style must remain constantly in contact with the bottom of the groove during reproduction, there is no necessity in the gramophone of having the style in contact with the bottom at all, as it may be supported by the upper surface of the tablet, the only necessity being that the sides of the style shall be in position to be struck alternately by the two side walls and thrown from one side to the other in rapid succession. The Berliner Gramophone employs a supporting arm pivoted on a universal joint to the main frame just as it has been pivoted in Edison's English Patent, 1644, but without any mechanical external feeding mechanism. The weight of this arm, together with the reproducer head and the horn, is carried upon a style as it rests in the bottom of the groove when starting the machine, and the extent of this pressure is totally immaterial within any reasonable limits; first, because the record cannot be destroyed, and, secondly because there are no vertical undulations in the bottom to have to counteract this weight as is the case in the Bell and Tainter structure. In view of the fact that in the gramophone machine all external feeding mechanism is entirely dispensed with, and the record groove made of such form and shape as to be capable of firmly holding the style and receiving any reasonable amount of weight, the internal construction of the machine becomes radically different from the Bell and Tainter devices, and because of the fact that the style is primarily in the groove in its proper position and must

of necessity always remain in such proper position, the defects or causes which necessitated the development of the Bell and Tainter invention never existed in the Gramophone machine. In the Berliner instrument the entire feeding of the style across the record tablet being performed by the groove itself it follows that there was no necessity for interposing any flexible or universal joint between the reproducer and the end of the old pivoted arm, and, consequently, the invention of the Bell and Tainter patent is not embodied in the gramophone machine. There being no external feeding mechanism which might by a positive feeding operation so displace the hinge arm or carrier relatively to the groove of the record tablet, there was no necessity of providing the reproducer with a mounting which will counteract said displacement due to feeding by causing the reproducer style to ride down the walls and centre itself on the bottom, and follow the said bottom to compensate for said displacement of the arm, but on the other hand, the position of the reproducer and the free end of the arm to which it is rigidly connected being positioned relatively to the groove, solely by the groove, acting upon the style point, it follows that the operation which is essential to the invention of the Bell and Tainter patent is entirely wanting in the defendants' machine. Moreover, the record groove in the gramophone, is not adapted to perform the functions of causing the reproducer style to gravitate to the bottom and rest upon a vertically undulating record at the bottom.

Adjourned until Tuesday, Feb. 26, 1901, at 11 A. M.

PHILADELPHIA, February 26, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of witness, R. M. HUNTER, continued.

(Witness continues his answer to Q. 14.)

The particular co-action between the wax record of the Bell and Tainter patent and the loose mounting of the style

or reproducer head is an entirely different one than that which is produced by the record tablet of the gramophone machine with the style carried by a reproducer rigidly secured to its carrier arm.^{7A} This difference in co-action between the record groove and the reproducer in the two machines is due to the difference in construction, and the necessary difference in operation due to this difference in construction. The grooves are different, the action of the grooves upon the styles are different, the displacements between the style and groove which constantly occur in the complainant's machine are entirely wanting in the defendants' machine, and the necessity of the invention in the complainant's machine does not and never did exist in the defendants' machine, and, consequently, the defendants' machine, does not embody the invention of the complainant's patent.

The gramophone has no loosely mounted style, and, consequently, does not embody the structure of Claims 19 and 22 of the complainant's patent. If my understanding regarding the scope and meaning of the other claims, 20, 21 and 23, is correct, they do not embody the structure of Claim 23, because they do not employ the record tablet having a record groove with irregularities or undulations in its bottom and sloping side walls, and this irrespective of the particular mounting of the style or reproducer, and they do not embody the structures of either Claims 20, 21 and 23, because they do not employ the special loose mounting for the reproducer of the character I have pointed out as being essential to the complainants' machine. The defendants' arm, to which the reproducer is rigidly connected, is only intended to definitely hold the reproducer in an upright position and sustain the sound horn, while the record tablet itself causes the propelling of the reproducer positively across the record tablet the full extent of the whole series of grooves, and as this arm is not held captive and mechanically moved by external feed mechanism, there is absolutely no possibility of any relative displacement between the style and the groove, and hence there is no necessity for introducing the flexible joint imme-

diately at the reproducer. As a matter of fact, the introduction of a universal joint between the free end of the supporting arm and the reproducer, as in the case of the complainant's patent, would be to introduce a defective construction, which would materially interfere with the proper operation of the machine. Besides, there being a double connection of the reproducer, namely, one with the horn and the other with the arm, it would be practically impossible to make such a connection in the defendants' machine. If we consider the horn in the gramophone as equivalent to the tubular parts I, 23, 21, 19, of the Bell and Tainter patent, then we will have the reproducer rigidly connected with this tubular horn extension or arm, the said horn being pivoted to the main frame, just as the horn and tubular arm is pivoted at 20 to the main frame of the Bell and Tainter machine. In the gramophone the horn and hinge arm may be taken as one structure, since they move as a unit and rely on the same hinge connection. In view of this it is clear that the gramophone does not embody in its construction the universal support 32, or its equivalent of the Bell and Tainter patent, and, therefore, does not embody the constructions of Claims 20, 21 and 23.

If the Bell and Tainter patent is to be given such legal construction that either of the claims 19 to 23, or all of them are to have such a meaning that they include generically the support of the reproducer or its style on any character of universal mounting, without limitation, as to construction or mode of operation or use in connection with a specific type of machine, then under such a condition it is possible that the defendants' apparatus might be included, but in this case the claims would be for the construction which is clearly shown in the Edison English patent, 1644, which unquestionably shows the reproducer carried upon the end of a supporting arm pivoted to the main frame upon a universal joint, and, therefore, would be anticipated. There can be no infringement under any construction of the patent that is less broad than one which would make the patent invalid.

While speaking of this Edison English Patent No. 1644, I have not lost sight of the fact that the complainants will contend that while the reproducer is supported on an arm capable of transverse movement, that the said arm is held captive, and therefore, is not free in the sense of the support for the reproducer in the Bell and Tainter patent, but I would point out that in the feeding mechanism of Figs. 9 and 10 there is no lateral captivity to the reproducer. In these constructions the reproducer is perfectly free to move from the centre outward at any time, and bearing in mind how exceedingly limited is the requirement of the adjustment to compensate for the irregularity within the purview of a groove, namely, something less than the hundredth part of an inch, it is reasonable to suppose that there is such a capacity as a matter of fact in any ordinary mechanical construction of those devices shown. I would also point out that in Figs. 6 and 7 the reproducers and supporting arms are entirely free against any captivity, and are, therefore, free to respond to any lateral adjustment dictated by the style in the groove. In these constructions, the rotating eccentrically arranged studs or pins on the central shaft, e, at intervals, once in a revolution of the record tablet, feeds the reproducer and then leaves it for the remaining part of the revolution free to follow the groove and its style to gravitate to the bottom thereof. Furthermore, in the construction shown in Fig. 8, the intermediate feeding gearing is of such a nature that it could not be made without a minute lost motion, and as this would be magnified by the great radius of the pivoted arm reaching to the reproducer, it is evident that this reproducer is not captive any more than the reproducer of the complainant's patent, but the style is free to automatically gravitate to the bottom of the groove and follow the groove within reasonable limits. I have before pointed out that the arms carrying the reproducer in this Edison patent are always free during reproduction to move about their transverse axis or in a direction at right angles to the plane of the record. They are, therefore, universally mounted, and with a reasonable

freedom of motion about their universal joint, so that, under any broad understanding of the claims of the complainant's patent in suit, said claims are completely anticipated by the said Edison English Patent, No. 1644. My understanding of the Bell and Tainter improvement over the Edison English patent, is illustrated in "Exhibit 39," and with an understanding in conformity with that opinion the defendants' machine does not embody the improvements claimed in the complainant's patent.

I would here say that there is nothing inconsistent with my views as expressed in this testimony, with the decisions which have been rendered in litigations based upon complainant's patent, and in this connection, I might say that in the *Amet* case, Judge Grosscup in effect held that the universally mounted reproducer, if not in use with an engraved wax record, performed no other than the ordinary function of every universal joint. In the *Leeds* case, Judge Shipman's opinion perhaps was inclined to go a little beyond the opinion of Judge Grosscup, and assumed a possible patentability in the particular universally mounted reproducer, because and in virtue of the function it performs in co-operating with the particularly vertically undulating engraved record of Bell and Tainter. I would point out here that in both of these cases the particularly wax record tablets involved in connection with the reproducers were the graphophone records.

Q. 15. You have, in the foregoing answer, assumed it as a fact that a universally jointed arm, used for the mere purpose of tracking a groove, is not patentable, or was not patentable at the date of Bell and Tainter's application. Please explain a little more fully why you express this opinion.

A. I have already explained my understanding of the presence of such a universally jointed arm carrying the reproducer disclosed in the Edison English patent, 1644, "Defendants' Exhibit, No. 11," but I would also refer to some other well-known uses of universally jointed arms for

insuring the ordinary proper tracking of a moving part, it being immaterial to the function of a universally jointed arm whether its free end track a wire or a groove. Arms of this character were very old and well-known long prior to the date of the Bell and Tainter application. An excellent example of a universally jointed arm for tracking an irregular wire and having a necessity for its presence, owing to the tendency of a feeding mechanism to misplace the tracking contact, is found in the well-known trolley system, in use throughout the United States and which is patented by me by numerous letters patent, and which was invented by me at least as early as 1881. In this case the trolley wire is required to be tracked or followed by the groove wheel of the trolley pole, and as it is not always parallel or in fixed relation with the track, over which the car is mechanically propelled, I employed the universal jointing of the trolley pole to permit the trolley wheel to maintain its tracking relation with the irregular trolley conductor or wire.

In "Defendants' Exhibit, No. 16," which is a translation from the well-known treatise of Physics and Meteorologie by Dr. Joh. Muller, there is described and illustrated a rheostat for introducing or removing a resistance in an electric circuit. The rheostat consists of a cylinder which has cut upon its surface a fine helical groove, and into this groove is wound a fine metallic wire so as to project slightly above the surface. The cylinder is adapted to be rotated by a crank. Parallel to the cylinder is a rod carrying loosely upon it a small wheel having a circumferential groove to receive the projecting portion of the helical wire. The rod upon which the roller is mounted is spring pressed toward the cylinder by springs at each end, one end of the springs being connected to the rod and the other end to the main frame. In this manner the roller is universally mounted, since it bears with yielding pressure upon the wire around the cylinder and is free to move laterally to follow the helical wire, it being free to rotate on the rod and slide longitudinally thereon. By this construction the roller or contact is pressed against

the periphery of the cylinder by universal mounting and is caused to track the spiral wire or record thereon by simply rotating the cylinder. In instruments of this kind, it is important that the pressure should be very constant, and it is so made that while the contact is being pressed against the cylinder and made to travel over the same under a yielding pressure, such pressure is practically kept constant.

Muller's book was published in 1858 in Braunschweig, Germany, and the rheostat there described is well known all over the world. Another form of rheostat of earlier date than that last described is shown and described in Peggendorf's "Annalen der Physik und Chemie," Vol. 59, published in Leipzig, Germany, in 1843, a translation of which article is here in evidence as "Defendants' Exhibit, No. 17." In this rheostat the small groove roller is journaled on the end of a weighted arm and runs in contact with the helical conductor on the cylinder. The other end of the weighted arm is hinged on an axis parallel to the surface of the cylinder, and said hinge is adjustable longitudinally or parallel to the cylinder. The cylinder is journaled in fixed bearing and one end of its shaft is screw-threaded with a pitch corresponding to the pitch of the helical conductor or spiral on the cylinder. By revolving the shaft with a crank the cylinder is rotated and uniformly fed forward longitudinally or in line with its axis, and the contact is a floating one and pressed downward upon the helical surface of the cylinder under the action of the weighted arm. In general make-up this machine is very similar to the general elements entered into the Edison phonograph particularly, of that shown in Fig. 13, of the English patent, 1644, but with the reproducer arm pivoted on an axis parallel to the axis of the cylinder as shown in Figs. 12 and 15 and also Figs. 1 to 10 of his said English patent, and Figs. 3 and 4 of his American patent, No. 227,679 of 1880.

Universally jointed arms are adapted to carry styles for track-grooves, and are quite common in engraving machines, some of which are called "rose engines." Such type of machine

is shown in "Defendants' Exhibit, No. 1," and also in "Defendants' Exhibit, No. 2." In this latter it is evident that the style carrying arm is universally jointed but the relative movement between the arm and the record is caused by hand power in place of an external mechanical feeding mechanism. In the case of "Defendants' Exhibit, No. 1," the arm carrying one style is pivoted so as to move the style to and from the article to be engraved under the action of a spring, and a second style is made to track the pattern or record to control the movements of the cutting style to and from the article to be engraved. Both the article to be engraved and the pattern are secured to the same rotating shaft, so that they move as a unit. The pivoted arms carrying the two styles are moved longitudinally by means of a screw and half nut similar to that employed in the phonograph machines. The general object of this engine is to produce engraved articles in accordance with the record on a pattern, on the same principle that in Fig. 59 of Edison's English patent, 1644, he proposes to reproduce or duplicate records from a pattern or master record. In his case, both the pattern and the work or duplicate are rotated, and the arm carries three styles, one for the pattern and one to engrave the duplicate record, and this arm is controlled as illustrated in the other portion of the patent, namely, by a feeding mechanism very similar to the rose-engine. We have, therefore, a close analogy between the old rose engine and the phonograph instrument.

"Exhibit No. 21" shows in the illustration one of Edison's phonographs with a universally jointed arm carrying the sound reproducer, the style of which tracks the sound record.

In addition to the above example, the universally jointed arm carrying the sound reproducer for tracking a sound groove, is also clearly shown in Figs. 1 to 10, of Edison's English patent 1644, of 1878, as I have before pointed out.

Edison's United States patent, 213,554, March 25, 1879 (automatic telegraph), also shows a universally jointed

arm carrying a style for tracking the groove, which groove, in this instance, is a telegraphic record groove. This patent is "Exhibit, No. 4."

Edison's patent, 227,679, of 1880 (Exhibit, No. 6), I have before pointed out, shows in Figs. 3 and 4, the pivoted arm carrying a reproducer and adjustable at its pivoted end longitudinally or parallel to the record cylinder, securing the results of a universally jointed arm under a generic consideration of a universal joint.

In addition to the above illustrations, I would refer to "Defendants' Exhibit, No. 33" which shows in Figs. 2 and 3, a lever mechanism carrying at the free end a style the adjustment of which levers permit the style to rise and fall to or from the record surface and also to transverse the line of the record transversely, thereby being in all essential respects a universally jointed arm. Moreover, it is so arranged that the style in effect floats under an exceedingly nice possible adjustment.

In all of these cases constant pressure is exerted upon the track, whether the same be a groove or a wire. A universally jointed arm adapted for the purpose of tracking, is such a common thing in the various arts that examples should hardly be necessary, but the above which are already exhibits in this case are thought to be amply sufficient as illustrations.

Adjourned until Feb. 27, at 11 A. M.

PHILADELPHIA, February 27, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of witness, R. M. HUNTER, continued.

Q. 16. You have in your previous testimony frequently referred to in the different record tablets found in the art prior to the Bell and Tainter patent, in suit, and more particularly disclosed in the Edison patents. Please prepare

a sketch illustrating the said early type of Edison record tablets, as well as the record tablet of Bell and Tainter, and that of Berliner, and used with the gramophone, with a view of comparing the record of these various tablets, and give any explanation relative thereto which you may desire.

A. I produce drawing showing a series of longitudinal sections and cross sections, one of each corresponding to a longitudinal and transverse section through each of the several record tablets of Edison, Bell and Tainter, and Berliner. Fig. 1 of this drawing shows the well known Edison tin foil record tablet in position upon the grooved cylinder. The cylinder is provided with the ridges A, and over the ridges so formed, the tin foil B, is bent, to form a series of parallel grooves having a vertically undulating bottom C, and sloping side walls, D. The right hand view is a longitudinal section in the length of the groove and shows the undulatory or irregular bottom, C. The left hand view is a transverse section showing the relation of adjacent grooves and illustrating the vertically undulating bottom and sloping walls. This record is what is known as the indented tin foil record, and is only one example of the various forms of indented records of Edison disclosed in his early work, and more particularly in his English and American patents, forming exhibits in this case. The indentations produce a vertically undulating bottom to the groove because, as the style vibrates the tin foil is moved at right angles to the direction or vibration and the resultant effect is a series of curvatures in the surface of the tin foil substantially as indicated in the drawing.

Fig. 2, Illustrates another type of the Edison indented records and obviates the necessity of providing grooves in the cylinder or turn-table upon which the tablet of tin foil is placed. In this figure a sheet of card-board is coated with paraffine or other wax-like substance. The tin foil, in this instance, is made very thin, and pressed upon the wax to give a very smooth surface, namely, one which may be subjected to the action of the indenting style without the possibility of any of the wax adhering to the style. The

record tablets of this construction had the grooves formed with sloping walls D, and a vertically undulating bottom C, as in the case of Fig. 1. B represents the wax, and A the support for the wax. The wax material in this case is substantially the wax of the Bell and Tainter patent. Another type of Edison wax record tablet is illustrated in Fig. 3. In this figure the general construction, so far as the arrangement of the wax D, and backing of cardboard A, is concerned, is substantially similar to that of Fig. 2, but, in this construction, no tin foil covering was employed, but instead the style was made to engrave the groove directly into the wax. In this wax record tablet the bottom C is vertically undulated as before and is bounded by the sloping walls D of the groove. B illustrates the wax, and A is the cardboard backing. This form of tablet is described in the Edison English patent 1644 of 1878, and paraffine or other wax compound or materials are employed as the wax coating to be thus engraved.

Fig. 4 illustrates similar views of the wax record tablet of the Bell and Tainter patent in suit. A is the cardboard, and B is the wax. In this case it is described as a mixture of paraffine and beeswax, the paraffine being greatly in excess. This tablet is formed with a series of parallel grooves having vertically undulating bottom C and sloping walls D. This is an engraved record tablet and, generically, is substantially the engraved record tablet of Edison shown in Fig. 3. It is true that in Bell and Tainter's patent they have a great deal to say about engraving, and removing the wax in chips, etc., to produce a clean cut record groove, but as their substance operates upon is substantially the same as the Edison, wax coating it is simply a question sharpness of the tool or style. Edison does not enter into fine discussions as to just how the record is engraved, but briefly explains the forming of the record grooves in the wax surface by the action of the recorder style, leaving it as a common sense view that the record groove will be cut or engraved. I have already pointed out, when considering the prior art, that cutting styles, like "burins" or a regular engraving tool point had been employed

for engraving vertically undulating records prior to the Bell and Tainter invention, so that it was open to any one to use a tool of this character, if not satisfied with Edison's engraving style, for the purpose of producing engraved record grooves in wax having sloping walls. I have before referred to the fact that Edison used the word "indent" and "indenting" in a generic sense as meaning the producing in the record surface of undulations, cut or formed in any of the numerous ways he points out in his patent, and in either of the forms of record surface. Aside from the definitions which I have already quoted from the standard dictionaries, I would refer to the definition of "indent" and "indentation" which I find in "The Century Dictionary and Cyclopædia." I find there the word "indent" to "make notches in like teeth, notch, jag * * * to make notches in resembling teeth; cut into points or jags like a row of teeth; jag, serate." The above refers to the word "indent" as a verb. When used as a noun the definition is: "a cut or notch in the margin, or a recess like a notch." The word "indentation" is defined as follows: "1. The act of indenting, or the state of being indented; the act of notching, or of cutting into points or inequalities like a row of teeth. 2. A cut or notch in a margin; a recess or depression." It is seen that under these definitions Edison did not confine himself to a mere embossing process, but comprehended in his patents, and especially in his patent 1644, the production of vertically undulating irregularities in the bottom and sloping walls to form a record groove irrespective of whether the said groove was produced by embossing or engraving, both being of his invention and both coming under the generic terms of indenting, indented and indentation.

Now, while the wax record tablet of Bell and Tainter and of Edison closely resemble each other, there appears to be some difference in the surface of the tablet at the junction or line of separation of adjacent grooves. As shown in the previous testimony of this case, the sloping walls of adjacent grooves meet in sharp ridges, so that no matter where the

style of the reproducer is placed upon the record tablet, it gravitates to the bottom of the groove, and rests upon the active or vertically undulating portion which is relied upon to vibrate the style. In the Edison wax record tablets this formation of sharp ridges between the adjacent grooves is not shown to be produced, not because they could not be produced, but simply because in the illustrations of the machines described in his patents the distance between centres of adjacent grooves appears to be materially greater than that of the Bell and Tainter patent. This, however, was due to the fact that the illustrations in the Edison patents were more particularly of the proportions designed to employ the tin foil record tablets, and in which case the ridges on the cylinder or turntable for supporting the tin foil were required to come between each groove, as shown in Fig. 1 of the sketch I am referring to in this answer, and this, of necessity, caused the grooves to be coarser or more widely separated than that of the Bell and Tainter patent. While in a wax record tablet of Edison it is not necessary to so widely space the grooves, but as he does not describe bringing them sufficiently close together to form sharp ridges at the apex of the adjacent sloping walls, I perceive this possible difference between the Edison wax record tablets and that of the Bell and Tainter patent in suit. This difference will be apparent by comparing the cross-sections of Figs. 3 and 4 of my drawing. In virtue of this difference, the particular co-action between the flexibly-mounted style or reproducer and the particular wax record grooves of the complainant's patent, is secured; namely, the capacity of the entire surface of the tablet, in which the record grooves are cut to co-act with the style and cause the same to gravitate to the bottom of the grooves under all conditions. In the Edison wax record tablets there would be a liability of the style not entering a groove but of resting upon the extended surfaces or lands which may be assumed as existing in a more or less defined manner between the adjacent grooves. In view of this it will be seen that aside from the specific im-

provement of introducing the flexible mounting for the reproducer upon the end of the old hinged arm or of very flexibly mounting the style whereby the style or reproducer may have capacity for lateral adjustment equal to the purview of a record groove, as I have before pointed out, Bell and Tainter also, perhaps, may be credited with the production of a specially formed wax record tablet of the engraved type in which the sloping walls of the adjacent grooves meet in a sharp or clearly defined ridge presenting no material surface upon which the style can lodge and become undesirably supported.

Referring now to Fig. 5 of this drawing, we have similar longitudinal and transverse sections of the record tablet of Berliner and employed in the gramophone. This tablet is not of wax and is not engraved. It has no gently sloping walls and has no vertically undulating record or irregular bottom. The undulations in the other record tablets are very clearly defined, but when we look at the corresponding view of the gramophone record tablet no undulations are perceivable, since the bottom is perfectly smooth, and the groove is a groove of even depth. The cross section likewise shows abrupt walls and with very extensive lands or flat surfaces between the adjacent grooves resembling more the Edison tablet, but materially different from anything corresponding to the Bell and Tainter tablet. The depth of the grooves are very great and form clearly defined upright walls adapted to act laterally upon the point of the style in the direction of the plane of the tablet surface. These side walls are the active portions of the groove. As I have before pointed out, the tablets of Edison and of Bell and Tainter have their grooves parallel so that the centre of one groove is intended to be of a uniform distance from the centre of the next groove, and any variation from this is a defect which is undesired, but which in the Bell and Tainter machine is compensated for by the slight free adjustment of the style. In the gramophone record tablet, however, these grooves are not parallel, but are wavy in plan and constantly present different configurations.

Adjacent grooves present different configurations in plan and, consequently, it is a physical improbability that any two adjacent grooves could be strictly parallel. This will be understood from an examination of Fig. 9 of Berliner Patent, 564,586, "Defendants' Exhibit, No. 28," or in the Berliner Patent, 548,623, "Defendants' Exhibit, No. 10." The style and reproducer which are adapted to operate in conjunction with the gramophone record tablet, shown in Fig. 5, is not adapted for operation in connection with the tablet shown in Fig. 4, namely, the Bell and Tainter tablet. It is further evident that the co-action between the reproducer and its style and the wax record which I have pointed out as peculiar to the Bell and Tainter patent, does not take place, and could not take place, in the gramophone machine employing the record tablet of Fig. 5, which is intended to illustrate sections of the tablet, "Complainant's Exhibit, Defendants' Sound Record."

The drawing produced by witness is offered in evidence and the same is marked: "Defendants' Exhibit, No. 40."

Recess.

Q. 17. In "Defendant's Exhibit, No. 34," in the affidavit of Thomas D. Lockwood, it is stated that Professor Alex. G. Bell referred to the phonautograph described in the said exhibit, in a communication to the Society of Telegraph Engineers, on Oct. 31, 1877, the same being printed in "Journal of the Society of Telegraph Engineers," Vol. 4, 1877, No. 20, page 404. Will you please produce a copy of the said publication, or so much thereof as is referred to?

A. I do so, and will quote the material portion of same.

"For some time I carried on experiments with a manometric capsule of Koenig, and with the phonautograph of Leon Scott.

"The scientific apparatus in the Institute of Technology in Boston was freely placed at my disposal for these experiments, and it happened that at that time a student of the Institute of Technology, Mr. Maurey, had invented an improvement upon the phonautograph. He

had succeeded in vibrating by the voice a stylus of wood about a foot in length which was attached to the membrane of the phonautograph, and in this way, he had been enabled to obtain enlarged tracings upon a plain surface of smoked glass. With this apparatus I succeeded in producing very beautiful tracings of the vibrations of the air for vowel sounds. Some of these tracings are shown in Fig. 20." (Fig. 20 merely shows seven different undulatory lines representing the vowel sounds produced by the apparatus.)

"I was much struck with this improved form of apparatus, and it occurred to me that there was a remarkable likeness between the manner in which this piece of wood was vibrated by the membrane of the phonautograph and the manner in which the ossiculæ of human ear were moved by the tympanic membrane."

Counsel for defendant offers in evidence the correct copy of portions quoted of the paper read by Professor Alexander Graham Bell before the Society of Telegraph Engineers, London, Oct. 21, 1877, Vol. 6, pages 385 to 481, and the same is marked "Defendants' Exhibit No. 41."

It is stipulated and agreed by and between counsel that the above exhibit, namely, "Defendants' Exhibit No. 41" is a correct copy of portion quoted of the paper read by Prof. Alexander Graham Bell, before the Society of Telegraph Engineers, London, Oct. 31, 1877, as published in the "Journal of Telegraph Engineers," Vol. 6, pages 385 to 481, and that the said Journal was printed in London, England in 1877, and that said exhibit may be used with the same force and effect, as though a duly proven copy of the publication were produced in evidence.

It is stipulated and agreed by and between counsel for the respective parties that all exhibits offered in evidence by the defendants in this case, which have not been set forth in Defendants' Answer, shall be accepted, received and used in evidence with the same force and effect as though reference to the said exhibits had been

duly set forth in the Answers of the Defendants filed in this case, where the same should have been so set forth in said Answers, according to the recognized practice, and all objection heretofore entered by the complainant of record to any such Exhibits as have not been set forth in the said Answer is hereby waived and cancelled.

Q. 18. Please state whether in your opinion, the Bell and Tainter Graphophone devices, as shown and described in the Bell and Tainter patents in suit, could be used for the purposes of a gramophone, and *vice versa*; and state your reasons for any opinion you may express.

A. If it were attempted to use an engraved wax record of the character described in the Bell and Tainter patent, with a reproducer of the defendants' machine, the result would be an immediate destruction of the record tablet, or at least the grooves therein, without obtaining any reproduction of the recorded sound. The character of style and reproducer and the particular mounting employed in the defendants' machine, would at once tear out the bottom of the record groove of the wax record tablet rendering it forever useless. There is no question upon this point. I have not personally made an experiment to ascertain it, but no experiment is needed, as it is a self-evident proposition. However, such an experiment was made by defendants' expert, Mr. Joseph Lyons, and has been testified to by him in answer to Q. 17 in a suit, American Graphophone Co. v. National Gramophone Co. and Frank Seaman, in the Southern District of New York, in which he states:

"I have done this myself, and I saw at once that it would be the height of folly to attempt to obtain reproduction of sound by a gramophone reproducer from a graphophone tablet. When I prepared for making the experiment, I knew beforehand that reproduction could not possibly be obtained in this fashion. I also expected to find that the style would injure the record, but I did not expect to find that it would so absolutely destroy it as it actually did. The graphophone tablet which I used

was a modern one, which is very much harder than the record tablet described in the Bell and Tainter patent in suit; still the gramophone style took hold of it like a chisel and simply scooped the groove out, making it useless for all future purposes."

It thus appears that it would be impossible to secure the co-action between the wax tablet and the gramophone reproducer, which is essential to the invention of the Bell and Tainter patent.

Even were we to suppose that the graphophone record had been constructed in hard indestructible material, such, for instance, as steel, we would still not have had the co-action required by the principles of construction of either the graphophone or of the gramophone, and no practical results would be obtained. This is evident from the fact that the gramophone diaphragm is arranged differently with respect to the style than what is required in the graphophone or Bell and Tainter instrument, and, consequently, it is not suited for reproduction with a record tablet in which the grooves are formed with vertical undulations in the bottom. An attempt of this kind would not produce a practical or salable instrument. Of course, any sonorous body will emit sound if it is agitated, but it will not emit clear articulate speech in the manner required by a phonograph instrument.

When it is attempted to reproduce sound from a gramophone hard composition record tablet by means of a graphophone reproducer, the latter must be mounted to be free to swing laterally across the tablet since the gramophone has no feed screw and gearing acting as an external feeding mechanism for propelling either the tablet or the reproducer head laterally. If this were attempted, it will be found that the reproducer is not properly formed as to its style to secure the requisite vibrations of the diaphragm and no satisfactory results could be obtained. Such an experiment as this was made by Mr. Joseph Lyons in the suit last above referred to, and in regard to which he testified as follows:

"I have made this experiment and the result was

just what I have described. There was a kind of reproduction, but it was a ludicrous kind of reproduction, such as would be repudiated both by the American Graphophone Co. and by the National Gramophone Co.; and would still more surely be repudiated and ridiculed by the public."

I am thoroughly of the opinion that the graphophone or the Bell and Tainter reproducer is wholly unfit to co-act with the gramophone record tablet to produce any practical reproduction, and likewise the graphophone or the Bell and Tainter record tablet is totally unfit for reproduction of sounds when employed in combination with a gramophone reproducer. Not only is this latter true because of the sure destruction of the wax tablet, but also because it is an impossibility for the wax tablet, with vertical undulations in the bottom of its groove, to properly co-act with the reproducer such as employed in the gramophone. The two modes of operation carried out in the two machines are entirely different and positively exclude each other.

Adjourned until Thursday, Feb. 28, 1901, at 11 A. M.

PHILADELPHIA, February 28, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of Witness R. M. HUNTER continued:

Q. 19. Please examine Claim 25, of Patent 341,214, dated May 4, 1886 to Bell and Tainter, which is one of the three patents in suit. You may state briefly whether or not, and if so, why, you consider this claim to be anticipated. You will then proceed to state whether in your opinion this claim is infringed by the defendants' devices.

A. Claim 25 is as follows:

25. "A reproducer having a style projecting beyond the edge or end of the instrument, so that the position of the point of style on the record may readily be seen, substantially as described."

This construction is illustrated in the Bell and Tainter patent in Figs. 7 to 10 inclusive. I have already at considerable length referred to this construction in my prior testimony. The statement in the patent which introduces this feature of the construction of the machine defined in Claim 25 is as follows :

"The invention consists, sixthly, in a reproducer or reproducing-instrument in which the reproducing-style, instead of being placed behind its support, projects at the point beyond the edge thereof. One practical advantage is that it enables the position of the style on the record or phonogram readily to be observed" (p. 2, lines 14-21).

Further on, after describing the details of the reproducer, the following statement appears :

"It will be observed that in both forms of reproducer the style 26 projects beyond the edge or end of the instrument, so that the position of its point on the record can be readily seen" (p. 4, lines 124-127).

This latter statement is almost in the language of the claim. The patent is wholly silent as to any utility of this alleged invention beyond that stated, namely, that the "position of the style on the record" can be readily observed. This, to my mind, is not such utility in a construction as to clothe it with the dignity of invention. I can understand that perhaps in experimental work in the laboratory, when certain experiments necessitate the careful observation of the action of the style on the record, under a microscope or magnifying glass, might be useful, but to provide such a possibility would merely be mere mechanical skill. It could have no utility in the practical use of the invention of the patent in suit, and, as a matter of fact, is not employed in the gramophone instruments. In this connection it is interesting to note that in the Tainter patent 341,288, in suit, filed six months after the Bell and Tainter patent application, and issued on the same day as that patent, this so-called improvement is entirely wanting, and nothing of the kind shown or

hinted at. Not only is it not shown, but a guard or cover has been added to the reproducer to shield or protect the style, and which would greatly obstruct its being seen over the mere location of it in the centre of the diaphragm. This same lacking of the use of the invention of the projecting style will be observed in the Tainter patent, 375,579, of 1887, also in suit; for here again the reproducer style is, in effect, completely shielded from view. In the graphophone instruments, and, in fact, all of the instruments alleged to have been made under the Bell and Tainter patent, lack the use of a style made in accordance with Claim 25. The acts of these inventors about the time of the patent, and subsequently, refute any allegation of invention, or of utility in any degree, in a commercial instrument of the character set out in their patent. The patent merely states that the position of the style may be observed, but it does not state why the position on the record should wish to be observed, or what good it would accomplish to observe it, especially when the closest observation in the commercial use of the instrument can be of no possible use to anybody. There appears to be no useful purpose subserved by exposing the point of the style to view; no inconvenience has ever been experienced, as far as I know, in the failure of the graphophone instruments to employ a style projecting so as to be observed; and no graphophone or instrument made under the Bell and Tainter patent, so far as I am aware, ever came upon the market with the point of the style projecting beyond the edge of the reproducer head. For these reasons, I am of the opinion that the construction stated in Claim 5 did not require in its conception or reduction to practice the exercise of the inventive faculties, and, therefore, does not rise to the dignity of an invention.

In the defendants' machine the style of the reproducer does project beyond the reproducer head, and is visible, but this is an incident to the particular character of the reproducer employed in the defendants' machine. It is visible because the reproducer head is used edgewise and not flatwise

as in the graphophone. The nature of the record in the gramophone compels the defendant to use the reproducer head in a different manner than it is used in the Bell and Tainter patent or the graphophone, and not because it is desired to look at the point of the style or because it would subserve any useful purpose whatever simply because of that projection. The style projects beyond the reproducer in the defendants' machine because it must connect the centre of the diaphragm with the groove in the record tablet and be positively pivoted or connected with the reproducer head in such a manner as to act as a lever and vibrate laterally in place of vertically, and, at the same time, support the reproducer, the hinge arm and the horn. In the defendants' machine, therefore, there is a useful, definite, mechanical construction required contemplating the projection of the style beyond the reproducer to enable it to co-act with the particular character of reproducer there employed, but in this construction the fact that the style may be seen was simply an incident. It, however, has another utility which is entirely wanting in the structure of the Bell and Tainter patent, namely, that in the defendants' machine the reproducer style is replaced after every couple or so of reproductions, and it is useful to be able to see the clamp into which the shank of the style is to be placed for attachment, but it is totally unnecessary to observe the contact of the point itself with the groove of the record tablet. The mere shielding of the point in the defendants' machine would hide it from view and by so doing it would lose all of that utility which Bell and Tainter ascribe to the projecting style; but it would thereby not lose any of its utility as a sound reproducer. The style of the defendant is not the style of the Bell and Tainter patent, but is very different in its construction and mode of operation. In the complainants' patent the style is carried wholly by the diaphragm and vibrates in and out with the diaphragm. In the defendants' reproducer the style is clamped in a metallic socket piece which is rigidly secured to the metal case of the reproducer and positively supported by it, and by the said

connection, the style mechanically supports the reproducer, its supporting arm and the horn. The defendants' style and its support rocks and is not carried by the diaphragm. The structures are, therefore, very materially different, and notwithstanding the fact that the point projects beyond the reproducer, and its contact with the record tablet may be observed, it does not follow that the defendants' style is the equivalent of the style of the Bell and Tainter patent.

The claim, however, when construed as Mr. Cameron construes it, namely, in such broad understanding as to make it include the defendants' style and reproducer, is fully anticipated in the prior art, as I have before pointed out, and to which prior art I will briefly refer. The patent to Hall, 219,939, of 1879, (Defendants' Exhibit, No. 5) employs a style carrying arm having the point at one end and the other end connected to the centre of the diaphragm, and the intermediate part of the style carrying arm pivoted or hinged in a universal manner to a frame which is rigidly connected with a reproducer frame resembling very much in mechanical construction the structure employed by the defendants, except that in the Hall construction the style projects laterally from the lever so as to operate in connection with a vertically undulating record as in the case of the Bell and Tainter patent. In Hall's patent, he describes both a single and double style; that is, a lever style adapted to operate with one record tablet or two record tablets. It will be seen by examining this patent that the arm carrying the style projects far beyond the reproducer head, and its contact with the record tablet (especially where one tablet is used) may be readily observed. The terms and substance of Claim 25 of the Bell and Tainter patent are fully met in this Hall patent, and the claim, if construed so as to include the defendants' structure, is fully anticipated. Other examples of styles projecting beyond the reproducer head, so as to be capable of being observed, are shown in Edison's English patent, 2909, of 1877, Fig. 8, for example, and Edison's English patent, 1644, of 1878, Figs. 17, 18 and 27. The

same is also shown in Edison's American patent, 227,679 (Defendants' Exhibit, No. 6), in Figs. 5 and 6, substantially the same projection of a style, so that its point of contact with the record tablet may be observed is shown in Defendants' Exhibit, No. 33, Figs. 2, 3 and 9, and, likewise, is shown in the phonautograph illustrated in Defendants' Exhibit, No. 34.

In my opinion, therefore, there is no novelty or utility in the construction described in Claim 25 of complainant's patent, but if it is assumed to embody any degree of utility which would entitle it to patentability, then under any construction or understanding which would make its terms include the defendants' structure, the claim would be fully anticipated by the prior art.

Recess.

Q. 20. Please examine Claim 44 of the patent 341,288, granted to S. Tainter, dated May 4, 1886, which is here in suit, and state, briefly, whether or not you consider this claim discloses anything novel over the prior art, and whether, in your opinion, its structure is embodied in the defendants' devices, and give your reasons for any opinion you may express.

A. Claim 44 of the patent referred to in the question, reads as follows :

"The combination, with the reproducer style, and the diaphragm or device upon which the reproducer reproduced sonorous vibrations are to be impressed by said style, of a flat metal spring interposed between the style and diaphragm, and forming a yielding connection, through which the reproduced vibrations are transmitted, said spring having a practically rigid connection with the diaphragm, substantially as described."

I have fully considered this claim in my answer to Q. 9, and it will, therefore, be unnecessary for me to more than briefly refer to the matter exhaustively treated of in that answer. Accepting complainants' expert's understanding of Claim 44 as correct, namely, a construction in which a flat spring is interposed between the style point and the diaphragm,

and a practically rigid connection between the spring and the diaphragm, I am of the opinion that the construction described in the claim is fully anticipated in the prior art. For example, it is shown in Edison's American patent, No. 200,521 (Defendants' Exhibit, No. 3), when the description is read in connection with the drawing, it is also disclosed in the scientific periodical, "Nature," for July 4, 1878 (Defendants' Exhibit, No. 20); also in Defendants' Exhibit, No. 15; also in Edison's English patent, No. 2909 (Defendants' Exhibit, No. 32), Figs. 5 and 29; and substantially disclosed in Defendants' Exhibit, No. 34, showing the phonautographic instrument of the Institute of Technology. I would refer again to Defendants' Exhibit, No. 20, because it is possible that Mr. Cameron may criticize the said exhibit in two particulars. First, that the description does not clearly describe the presence of the style point, and, second, the presence of the small rubber pads will prevent the connection between the diaphragm and the spring being termed a "practically rigid connection." Any such contention on his part would be unreasonable, but as such contention is a possibility it may be well for me at this time to add to what I have already said with regard to this exhibit. The description immediately below the illustration refers to the "embossing point," and in the language below this I find the following words:

"On using the curved membrane for embossing as well as reproducing * * * * the embossing could be done at a distance of over fifteen feet from the phonograph and be reproduced with clearness."

This language shows that the embossing point illustrated in the drawing is the reproducing style.

As I have before stated, the pads are very thin rubber layers which have practically no material elasticity, but which are designed simply to prevent undesirable sounds which might be produced by more rigid structures at the point of connection of the wood strut between the spring and centre of the diaphragm. These little pads do not interpose

any elasticity which would in any reasonable sense prevent this wooden connection as being a "practically rigid connection." Without the little pads we might say that the structure would be rigid, but with the interposition of these thin pads, the term "practically rigid connection" exactly describes it, and I believe that this illustration and description is a most complete anticipation of the alleged construction of Claim 44.

With respect to the question of the embodiment in the defendants' apparatus of the structure of Claim 44, it is quite evident that the style connection used by the defendant is entirely different in detail from any structure shown in the Tainter Patent, and I am of the opinion that no legal understanding should be given to Claim 44 which would make it of sufficient scope to include the defendants' structure. Claim 44 requires that the spring employed shall be a slender flap spring interposed between the style and diaphragm of the reproducer, and that it shall form a yielding connection between the style and diaphragm. It further requires that the vibrations of the style shall be transmitted to the diaphragm through the spring, and to accomplish this it requires that the spring shall have a practically rigid connection with the diaphragm. I understand these requirements to be such that the style and diaphragm must be arranged substantially one above the other with the flat spring interposed between them, and the practically rigid connection arranged between the spring and the diaphragm and approximately close to the style. The construction required is such that the thrust upon the style in the direction of its length is to be that which directly acts upon the diaphragm through the practically rigid connection. No such construction as this is found in the defendants' reproducer. All of these requirements are answered by several of the structures of the prior art, but none of them are fulfilled by the defendants' reproducer. In the defendants' reproducer there is a solid lever extending radially across the diaphragm and projecting beyond the edge of the reproducer, the free end of which rod is detachably

connected with the style point for the purpose of being frequently changed for reasons already pointed out. The style point itself is quite rigid, so that it forms an extension of the rigid lever or rod. The end of the rod at the centre of the diaphragm is cemented to the said diaphragm by beeswax, so that, at this point, it is a connection with the diaphragm equally, if not more so different from the complainants' patent, than is the case with the reproducer in "Defendants' Exhibit, No. 20." This style lever is provided at its middle with a lateral portion of considerable thickness, which, for an exceedingly short space, is reduced in thickness for the purpose of forming a spring fulcrum. The lever rocks upon this lateral projection, which is screwed rigidly to the case of the reproducer head. The part which extends laterally and forms a fulcrum is certainly not a long, thin, flexible spring of the character shown in complainants' patent, is not between a two-part structure, namely, the style and the practically rigid connection, as called for by complainants' patent, and is not parallel with its free end movable to and from the diaphragm, as is necessary to the construction of Claim 44 of the complainants' patent. It therefore does not embody the construction of Claim 44.

Even if we assume that the reduced lateral projection of the lever constitutes a spring fulcrum, the spring element is so short and stiff that it could not, under any operation, be useful in the manner required by the slender spring of the complainant's patent. It would be wholly useless except as to serve the function of a fulcrum or pivot, for the lever style, and its location is such that it performs this function at a position which is greatly removed from the diaphragm, namely, a position which could not be assumed for the free end of the spring in the complainant's patent. The two devices are, therefore, materially different. This spring is not interposed between the style and diaphragm, as it is at right angles to both, and is also entirely to one side of the diaphragm. It forms no yielding support for longitudinal vibrations through the style as no such vibrations are transmitted to the dia-

phragm in the defendants' structure, said vibrations being only lateral ones due to the rocking of the style lever, which, moreover, is integral with the so-called spring fulcrum. The lateral projection being in one piece with the style lever might be said to be rigidly connected with it, but not with the diaphragm. None of the requirements either of construction or mode of operation, of Claim 44 of the complainant's patent, are embodied in the structure of the defendants' reproducer. The claim is a specific one and is peculiar to the class of machine shown in the complainant's patent, namely, one in which the record tablet has grooves with vertically undulating record surfaces, and is not suitable for use in connection with a record tablet of the character of defendants, namely, one which is provided with laterally undulating record surfaces. If the claim is construed as Mr. Cameron construes it, it is anticipated by the prior art, and whether so construed or with more reasonable and common sense limitations, its structure is not embodied in the defendants' machine. That this is reasonable is evident from the fact that according to Claim 44 the vibrations of the style must be transmitted to the diaphragm by the spring, and it is clear if the spring were removed the vibrations of the style could not be transmitted to the diaphragm. In the defendants' device the vibrations are not dependent upon the so-called spring at all as this fulcrum might be substituted by a hinge as shown in Berliner's Patent, 372,786, "Defendants' Exhibit, No. 36," or Berliner's Patent, 564,586, "Defendants' Exhibit, No. 28," and the vibrations continue to be performed perfectly. The fact that the lateral fulcrum projection is thinned down to give it some elasticity does not warrant any understanding of said device to bring it within the terms of the delicate flat spring of the complainant's patent.

I have, in dealing with the 44th claim of complainants' patent, considered it under the assumption that it covered, or was intended to cover, the structure in the broad language stated by the complainant's expert, but a careful reading of the patent, taken in connection with the illustration, leads me

to believe that perhaps the complainant's expert is in error in assuming that the claim was ever intended to have such a meaning as he ascribes to it. Under his interpretation of the claim it is devoid of patentable novelty and I, therefore, lean rather to a legal construction of the claim which might import into it some feature of novelty which would distinguish it, even to a small degree, over the prior art. I will now explain what other construction might be given to this claim, and which is, perhaps, the correct and only one which should have been given. Figs. 4 and 11 show a construction in which it will be observed that the style point is not in alignment with the practically rigid connection between the diaphragm and the spring, but are out of alignment so that the free end of the spring, 359, overhangs the practically rigid connection with the diaphragm and the style point operates upon this free end. In this construction, it will be seen that the free end of the spring has considerable elasticity, and might take up vibrations to a greater extent or amplitude than such as would be given to the diaphragm. In other words, this overhanging spring would be of quicker return than the diaphragm, or be capable of normal vibration quicker than that of the diaphragm, thereby forming a yielding connection between the style point and the practically rigid connection with the diaphragm, whereby it will not only transmit the vibrations of the style to the diaphragm, but "may perform this function and also that of absorbing the foreign vibrations," as stated on page 3, line 93. I find that the patent describes this construction as follows: the spring, it states, is

"a light flat spring, 359, fastened at the lower end 360 of the reproducer."

The style is described as being arranged at the end of the spring, and the "practically rigid connection" is described as of "cork" or of metal if desired, and its function is stated

"it serves the double function of pressing the diaphragm against its seat and also communicating vibrations to it."

Its position is stated as

"preferably it occupies a position intermediate to the style 357 and the edge of the diaphragm as shown" * * *

And in this position it is stated that

"there is a certain length of the spring 359 beyond the cork, which length forms a tongue with a very high rate of normal vibration. It absorbs a considerable portion of the small vibrations which produce scratching noises, and it thus makes the articulation more distinct." (Page 6, col. 2.)

I further find that it is stated regarding this spring that it "should be of quicker return than the diaphragm." (Page 3, line 91.)

And that the use of such a spring improves the results

"by the interposition of a flat metal spring in such a way that while serving as a means of communicating vibrations to the diaphragm it can be bent independently." (Page 3, line 63.)

With this understanding of the construction of Fig. 11, which, Mr. Cameron says, embodied the invention of Claim 44, we see that the meaning of the said claims is more specific than that which he proposed to give to it. In the first place, the flat metal spring is stated to be "interposed between the style and diaphragm." Second, it is to form "a yielding connection" between the style and diaphragm through which the reproduced vibrations are transmitted, and it is further stated that the said spring is to have "a practically rigid connection with the diaphragm." These requirements fulfill the specific requirements of the parts above quoted from the specification. If the practically rigid connection is back of the style, or in direct alignment with its point, the yielding connection formed by the spring no longer exists between the style and the diaphragm, and, hence, the requirements of the claim would not be fulfilled. Moreover, the function of the "practically rigid connection" between the spring and the diaphragm is stated to be for the double purpose "of pressing the diaphragm against its seat,

and also of communicating vibrations to it." Because of the necessity of holding the diaphragm to its seat, and being the sole means for accomplishing this it is required to be "practically rigid," and in this it was supposed to differ from the prior Edison constructions shown, for example, in English patent, 1644, in which the connection between the spring and the diaphragm was a short piece of tubular rubber set on its side. In Edison's case the diaphragms were always attached to the mouthpiece in some firm manner, and the connection with the spring, therefore, was not required to hold the diaphragm in place, and hence, it was made more elastic. This is the only distinction which can be made between the structure of Claim 44 and Fig. 18, for example, of Edison's English Patent, 1644, for otherwise they are identical.

Another claim directed to the same construction, but in more specific language, is Claim 50, which reads as follows:

"50. The combination, with the diaphragm and its frame, of the spring projecting over said diaphragm, the block between the spring and the diaphragm, and the style bearing upon the spring beyond said block, substantially as described."

This claim is specifically directed to the construction shown in Figs. 4, 11, 13, as well as in Claim 44, for in both of these constructions the spring to the extent of its length between the style and the block forms "a yielding connection" as required by Claim 44. Figs. 17 and 15 do not embody this construction, but do embody the broad idea of employing the flat spring and the practically rigid connection for the purpose of holding the loose diaphragm in position upon the reproducer head, and these constructions are covered in Claims 48 and 49, which read:

"48. The combination with the diaphragm, its supporting frame, and the style of the spring for straining said diaphragm, substantially as described.

"49. The combination, with the diaphragm, and its supporting frame, of the spring pressing inward on said

diaphragm and the style carried by said spring, substantially as described."

From the language of these claims, it will be seen that there is no limitation whatever with regard to the point of connection of the style with the spring, or its relation to the means (practically rigid connection) by which the spring presses upon the diaphragm. These claims would include all of the different reproducers shown. They would not, however, require the overhanging portion of the spring between the style and rigid connection to form a "yielding" support to the style, as is necessary to Figs. 4 and 11, although they would include such a construction. In both Figs. 17 and 15 the point of the style is directly in alignment with the practically rigid connection between the spring and the diaphragm, although this at first glance does not appear to be so in the case of Fig. 15. In consequence of this relation there is no overhanging or yielding extension of the spring, and yet a material portion of the invention of the patent is embodied in these constructions, and is covered in other claims than 44. The patent states with regard to the position of the block or rigid connection between the spring and the diaphragm.

"preferably it occupies a position intermediate of the style 337 and the edge of the diaphragm, as shown; but it can be set directly opposite the style."

This was with reference to the description of Figs. 4, 11 and 12 and was, therefore, indirectly making reference to a construction shown in Figs. 15 and 17. I would also point out that another improvement found in Fig. 15, as well as in Fig. 11, and not in Fig. 17, is the style made of a thin piece of sheet metal set on edge, and in that position secured to the spring.

If my understanding of the meaning of Claim 44 is as above pointed out, and is to be the proper legal construction to be given to this claim, it is quite clear that the style of the defendants' reproducer is not mounted in this manner and that the said reproducer does not embody the specific features

required by the claim. The defendants' style, as I have before pointed out, is part of a long, rigid lever parallel to the diaphragm, fulcrumed in a positive manner to the metallic case of the reproducer, entirely beyond the diaphragm, and the end opposite to the point is connected with the centre of the diaphragm by means of beeswax. No comparison is necessary with the construction of the Tainter Patent, 341,288, to show that such a construction does not come within the terms of Claim 44, as it is a self-evident fact at a glance, and this question may be dismissed without further remark.

Adjourned until Friday, March 1, 1901, at 11 A. M.

PHILADELPHIA, March 1, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of Witness R. M. HUNTER, continued :

Q. 21. Please examine Claim 20 of Patent, No. 375,579 granted to C. S. Tainter on Dec. 28, 1887, which is here in suit. Please state briefly whether said claim is for anything which is not anticipated in the prior art and whether, in your opinion, the defendants' reproducer embodies the structures set out in the said claim, and give your reasons for any opinion you may express.

A. Claim 20 of the Tainter patent, 375,579, is as follows :

"20. The combination, with the diaphragm of the reproducer, of the rubbing style consisting of a lever having the rubbing point formed on one arm and the other connected with said diaphragm, substantially as described."

I have already exhaustively considered this claim in my previous testimony, and have there stated and now state that in my opinion the construction is fully anticipated by the American patent to Edison, 227,679 of 1880, "Defendants'

Exhibit, No. 6." In addition to the Edison patent above referred to I consider the claim is anticipated in the phonograph disclosed in Defendants' Exhibit, 34, and also in the American patent to Hall, No. 219,939, of 1879, "Defendants' Exhibit, No. 5." I have so fully considered these patents in my answer to Q. 9 that I would refer to that answer, and not take up the time at this point for a repetition of my views with regard to these anticipations.

I, however, wish to point out a little more fully that the so-called lever having two arms is in a mechanical sense identical to the lever shown in the Edison patent, and this must, of necessity, be conceded if the defendants' style lever is to be construed by the complainant as coming under the terms of Claim 20. I produce a sketch, which will be marked "Defendants' Exhibit, No. 42." This sketch contains four figures. Fig. 1 represents the lever of Edison's patent, Defendants' Exhibit, No. 6, A being the lever carrying the style point D at its one end and fulcrumed at 15 at the other. This lever is connected at the middle with the diaphragm b. Assume that a saw cut is made as indicated at B, Fig. 2 in the lever A, of Fig. 1. We now have two clearly, defined arms on the lever A, and both of said arms point in the same direction with regard to the pivot 15, one of said arms is connected to the style D, and the other to the diaphragm b. There is, however, not the smallest mechanical change in the construction from what is shown in Fig. 1 of the Edison patent. Now, assuming that for any reason it was desired that the diaphragm should be set at an angle as in Fig. 3, it would simply mean that the saw cut B, should be spread so that the shorter arm would be approximately parallel to the diaphragm, but the integrality of the lever structure carrying the style point, D, remains mechanically the same as it did originally; the leverages of the arms are precisely the same, and the operation of the instrument is the same whether said arms are separably distinct to the eye or are blended in the manner shown in Fig. 1 or in the Edison patent. Assuming still further that it was desirable

to set the diaphragm considerably off to one side, and at right angles to the original position assumed, it would only be necessary to spread the arms produced by the saw cut a little more and we have the construction shown in Fig. 4. It is self-evident that there is no difference in mechanical constructions, modes of operation or the results produced in either one of these constructions, or equivalent modifications of the same structure. Fig. 4 is what is shown in the complainants' patent, but Claim 20 as drawn includes all of these structures, and is, therefore, fully anticipated by the Edison and other patents referred to above.

With respect to the question of the embodiment of Claim 20 in the defendants' machine, depends somewhat on the legal construction given to the claim. The terms of the claim require that the style and lever be formed in one piece; that is, be of an integral structure. It is so shown in the patent, and the claim practically makes this requirement. If this limitation is to be read into the claim, it might be that the claim is to this extent distinguishable over the prior art to which I have above referred in that, as I understand them, the styles are affixed to the lever. If the claim is so restricted, then it is self-evident that the defendants' device does not infringe the claim, since in the defendants' reproducer the style point is removably secured to the lever, and is frequently changed during its use, as I have before pointed out. While on this question of the scope of the claim, I might direct attention to the two-armed lever style, 382, of Fig. 15, of the Tainter Patent, 341,288, in suit, said patent having been issued prior to the filing of the application on which the patent, 375,579, in suit, was granted. The style, 382, is a lever, which is hinged at 383, thus having two arms, one of which is integral with the style point, and the other of which is connected with the diaphragm at 384. I would point out the fact also that the leverage between the fulcrum point, 383, and the style point is greater than the leverage between the fulcrum point and the connection with the diaphragm. This prior patent of Tainter, therefore, seems to meet even

the limitation above suggested, namely, of employing the style point as an integral part of a two-armed lever, I, therefore, lean to the view that the claim is fully anticipated and lacking every vestige of novelty.

Counsel for defendants offers in evidence the sketch produced by the witness, and the same is marked, "Defendants' Exhibit, No. 42."

Q. 22. Please state whether, in your opinion, the perfected graphophone instrument produces with all of its improvements, including those alleged to be embodied from the several patents here in suit, or either of them, better results than that produced by the gramophone instruments embodying the principles of construction of the defendants' machine.

A. I am thoroughly of the opinion that the gramophone instrument is greatly superior in its reproduction over the graphophone. I have heard and carefully noted the effects and results of these two classes of instruments, and especially with the better types of them, and believe that the results of the gramophone are in every way more satisfactory. They are loud, more distinct, and more accurate. Moreover, the gramophone is far more simple and easy to handle, and its record tablets are much more lasting under use. The great superiority of the results which can be produced by the gramophone are due to the entire difference in construction and mode of operation which it has with reference to the graphophone. These differences having already been pointed out by me.

Q. 23. Please state whether the effect would be the same in the Bell and Tainter machine, and the gramophone under conditions where the style left the record surface during the act of reproduction.

A. It would not be the same. In the Bell and Tainter patent, the vertical movement of the style is exceedingly small, and it is a very delicate operation for the style to follow all of the undulations of the record groove, bearing in mind that the style is positively moved in one direction by

the surface of the record itself and is moved in the other direction under the action of the resiliency of the style and its support. There was liability in an instrument of that character of the style not responding quickly enough in riding down from a crest of the record into the following depression where the amplitude was great and the sound was at high pitch and the result was that the style would leave the record and jump to the next raised portion of the record surface, thus destroying the real results that should have been accomplished. This failure to properly follow the surface of the record, or at least the maximum points of amplitude, greatly destroys the sound. Mr. Tainter, in his patent, 341,288, in suit, which is stated to be an improvement upon the Bell and Tainter patent, refers to this uncertainty of action of the Bell and Tainter instrument, and in referring to it, says:

"Another difficulty in reproducing is the passage of the style from one elevation of the record to the next without descending to the bottom of the space between."

and which he says "sometimes make the reproduction unintelligible," (page 3, lines 81-86).

It is quite evident that in an instrument employing the vertically undulating record it is absolutely essential that the style shall continuously follow the continuous surface of the record in the tablet, if proper sounds are to be produced, since it is only by this action that the full amplitude of the vibrations can be secured. If the style should fail to touch the record surface, even by perhaps a millionth of an inch, the defect of reproduction would be at once apparent.

This is not so in the gramophone because the record groove in that instrument operates upon the style by the sides of the groove, and according to the angle of said sides, horizontally considered with respect to the longitudinal line of travel of the groove, they will strike the sides of the style with greater or less force, and the style will be compelled to vibrate with the full amplitude of the laterally undulating

record. The impact of the side of the record groove on the style may cause the latter to leave that surface, namely, that of the other side, and, in this manner, it positively moves to the full extent under all conditions, and this, too, irrespective of the fact that it may alternately be in contact with two sides of the groove when vibrating and might leave either side during this operation without failing to accurately produce the sounds which the record groove is intended to produce. This shows that the principle of operation of the two instruments is very different, and that what would be fatal to one may exist in the other.

Recess.

Q. 24. Please describe the complainant's apparatus known as the graphophone which is now on the market, and in more or less extensive use, compare it with the Bell and Tainter patent in suit, and state whether or not any features of merit which it may embody are the subject of letters patent issued subsequent to the date of the Bell and Tainter patent in suit, and if so, what patents.

A. I have examined numerous graphophone instruments and would point out the following features thereof: The mandril or cylinder which receives the record tablet has a tapering surface designed to permit a cylindrical cast record blank or tablet to be slipped on and off easily and to produce sufficient friction to hold it in position when on. This construction is not found in the Bell and Tainter patent in suit, but is made the subject matter of letters patent, 386,974, July 31, 1888, to T. A. Edison.

The record tablet employed with this mandrel is provided with a tapering hole or bore while being cylindrical upon the outer surface. Such a tablet is not shown in the Bell and Tainter patent, but is made subject matter of letters patent, 382,418, May 8, 1888, to T. A. Edison.

The cylindrical record tablet appears to be formed of wax or wax-like materials, having substantially the same coefficient of expansion, and to be cast or moulded with a tapering bore. This construction is not shown in the Bell

and Tainter patent, but is made subject matter of patent 382,462, May 8, 1888, to T. A. Edison.

The graphophone record tablet is made cylindrical with a tapering bore, and has internal ribs or projections. These features are not found in the Bell and Tainter patent, but are made subject matter of letters patent, 414,761, November 12, 1889, to T. A. Edison.

The record tablet used with the graphophone is not a composition of paraffine and beeswax as described in the Bell and Tainter patent, but appears to be of the character of metallic soap, such as described in claim in letters patent, 430,274, June 17, 1890, to T. A. Edison.

The recording diaphragm forming part of the apparatus, and also the reproducer, has a diaphragm of glass, and this is not shown or described in the Bell and Tainter patent, but is made subject matter of letters patent, 400,646, April 2, 1889, to T. A. Edison.

The recording diaphragm carries a recording point or style having a cutting edge located in such a manner as to engage the surface of the blankets at an acute angle. This construction is not shown in the Bell and Tainter patent, but is made subject matter of letters patent, 393,967, December 4, 1888, to T. A. Edison. The same general device is claimed and described as an article of manufacture or apparatus in letters patent, 393,968, to T. A. Edison.

The recording diaphragm carries a cutting tool having a curved edge. The exterior line is in a circle and the record is cut in the arc of a circle. The reproducing diaphragm has a ball or tracing point adapted to travel the groove cut in the arc of a circle. Both of these devices are shown, described and claimed in letters patent, 430,278, dated June 17, 1890, to T. A. Edison.

Assuming that the graphophone record tablet is a phonogram of wax-like material, it will, in use, be combined with a jewel cutting tool, and will, therefore, embody the subject matter of letters patent, 484,583, dated October 19, 1892, to T. A. Edison.

The phonograph instrument employs a record tablet of a wax-like material and a rounded jewel style not affected by chemicals, and such a construction is not shown in Bell and Tainter patent, but is made subject matter of letters patent, 484,584, October 18, 1892, to T. A. Edison.

The other points of the graphophone have been very largely copied from the Edison early English and American patents, as I have before pointed out; that is to say, their machine embodies the rotating cylinder for carrying the record tablet, power devices for rotating the said cylinder at a uniform speed, external mechanical feeding devices for producing a rectilinear feeding of the reproducer across the record tablet, a hinged arm for the reproducer whereby it may be moved to or from the record table, means employed in connection with the external mechanical feeding devices whereby said devices may be thrown out of operation and the reproducer returned over the tablet to repeat the reproduction or to start a new reproduction, the employment of a style formed on a lever principle, and a wax-like record having its surface engraved and forming a helical groove, having a vertically undulating record in its bottom and sloping walls. It will thus be seen that the essential features of the graphophone as an organized machine are not the inventions of Bell and Tainter, or either of them, but are the inventions of others, and are fully disclosed in letters patent, some of which patents are still in force while others have expired.

Adjourned until Monday, March 4, 1901, at 11 A. M.

PHILADELPHIA, March 4, 1901.

Met pursuant to adjournment.

Counsel present as before.

Adjourned until Wednesday, March 6, 1901, at 11 A. M.

PHILADELPHIA, March 6, 1901.

Met pursuant to adjournment.

Counsel present as before.

Examination of witness R. M. HUNTER, continued :

Q. 25. Mr. Cameron, complainant's expert, gave it as his opinion that in defendants' gramophone machine the reproducing style snugly fits the record groove ; that it consequently presses simultaneously against and rests upon both walls of the grooves, and that, therefore, the style bears with yielding pressure upon the lateral irregularities which represent the sound record in the groove.

You, on the other hand, have, in your preceding testimony, shown that in the defendants' devices the reproducer style does not normally bear upon the two walls of the record groove. Will you now consider this difference of opinion and be a little more full upon this question, giving such additional explanation as you may wish with a view of further establishing the correctness of your views and the incorrectness of the opinion expressed by Mr. Cameron?

A. Mr. Cameron refers to the action of the style and its relation to the walls of the groove in defendants' machine in Q. No. 9, and also in his answer to X Qs. 311 to 314 inclusive. In his answer to Q. 9 he says :

"I find that the grooves are exceedingly fine and thread-like and quite shallow and that notwithstanding the fact that the reproducer point seems sharp to the touch, that it is, when compared with the thread-like groove of the record, quite blunt. When the point of the style rests in the groove it travels along the bottom thereof, fully filling the groove and contacts at all times with the walls of the groove on both sides ; that is, the style does not move back and forth across the groove, but fits snugly therein so that the sloping walls of the groove acts simultaneously on the opposite sides of the style point and guides the same."

In his testimony, under cross-examination, Mr. Cameron states with considerable fulness, the method which he em-

ployed for ascertaining the relation between the style and the record groove. He shows that he took a cross-section of the gramophone plate and held the plate vertically; and that he properly mounted a gramophone reproducer head and allowed its style to drop into a record groove, and rest in the same by gravity, and then examined the groove and style together from all imaginable positions under microscopes with powers of fourteen to thirty diameters. If the style retains the relation to the groove which it occupied in practice, then it was in an oblique position relative to the surface of the plate, and all of the various parts which are in the alleged contact of Mr. Cameron, are curved surfaces lying in almost every conceivable plane, and it would be a practical impossibility to arrive at any definite and reliable results from such an examination. In the procedure of Mr. Cameron, the style was sometimes brought forward toward the cross-sectional plane as far as possible without slipping off, and sometimes it was placed in the groove some distance behind this cross-sectional plate. With such positions of the objects to be examined the microscope was moved around them, sometimes directly towards the cross-sectional plane, and sometimes towards the surface of the tablet. It seems to me that such a procedure would be totally unreliable and that no results of a practical value could be secured in any such manner. With a large magnifying power it is evident that the different parts of the groove and style would require different focal adjustments to bring them into the focus of the lens, and that it would be practically impossible to bring the line of contact between the sides of the style and the sides of the groove into such focal position, because the curvature of the groove in cross section is a different section than a transverse section through the style in a plane parallel with the centre of the style. It would be next to an impossibility to make these two curvatures the same so that when the style is set into the groove in an oblique position the curves of its point would mathematically fit the curved walls and bottom of the groove. To the eye they may appear to meet but under the mode of

examination made by Mr. Cameron, the enormous difficulty in securing any proper focus would cause the side portions of the style and groove to coalesce to the eye, and even in a photographic reproduction, even though the style were materially narrower than the groove. I have undertaken myself to make these examinations and believe that they are totally unreliable when made in conformity with the statements of procedure testified to by Mr. Cameron. The gramophone record grooves are about $\frac{1}{250}$ of an inch in width, and a style which may be quite loose in such a groove with regard to pressure on the side walls thereof, may leave on either side between itself and the walls a space of not more than $\frac{1}{2000}$ of an inch. To look into such a space by a microscope of any kind, under the conditions stated by Mr. Cameron, would be absolutely futile; especially is this so in view of the fact that the hard rubber wall of the groove is dark and the curved surface of the style is highly reflective. Of course it is possible to turn the light upon the wall of the groove to make it reflect as itself as a white surface under large magnifying power, but this would be greatly confusing in making such examination as that proposed. Furthermore, as I have above pointed out, the line of alleged contact is not a straight line, and is not even a curved line in a plane, but is a very irregular curved line in a multiplicity of places if it exists at all, and under no conditions could all these points of contact be examined at the same time. The smallest jarring might bring an abnormal contact between the style and the side of the groove into existence, and, thereby, produce a deception. I would also point out that it would be practically an impossibility to simultaneously examine both sides of the groove and contact with the style, for whatever favorable position or reflections of light might be secured on one side would not exist on the other side of the groove, and it is quite evident that the style point might be crowded over against one side which was more particularly examined while at the same instant it was clear of the opposite side. In my opinion it is

of no consequence what the character of illumination produced by Mr. Cameron may have been, because the diffraction of light which would come through a narrow slit as small as $\frac{1}{1000}$ of an inch, would induce the phenomenon of light interference, which is well known to all persons accustomed to handling a microscope, and said light interference would produce the most defective results. However, even if this diffraction of light did not interfere with the proper examination, in this particular case, by producing darkness or apparent contact between the style and the side wall, the attempt to focus both sides of the groove and their contact with the style, would certainly coalesce the images of the sides and style and thus prevent any reliable data being secured.

I have made some very careful examinations with regard to the relation of the style to the groove in the defendants' machine under the microscope, and am thoroughly convinced that in the practical operation of the defendants' machine, the style does not rest and travel upon the two lateral walls of the groove so as to be sustained upon the sound record portions of the groove, and continuously in contact therewith. Mr. Cameron may have overlooked the fact, in his examinations that the style points are not all uniform in size, and that some are materially thicker than others, but the largest are shaped and intended to be so shaped, as to enable the point to rest solidly upon the bottom of the groove when placed in the machine. The fact that the point is intended to rest upon the bottom is primarily evidence that the side walls are not intended to act upon the sides of the style to prevent the point reaching the bottom of the groove. The great weight in the reproducing apparatus of the gramophone is a reason of itself why the style should not bear upon the side walls any more than is necessary during the action of the apparatus to reproduce speech. The weight is taken upon the bottom of the groove or upon the upper shoulders produced in the manner I have before pointed out upon the style and which rest upon the upper surface of the tablet and thereby aid the point in sustaining the weight and placing upon the

side walls of the groove alone the duty of producing lateral vibrations of the style. My examinations convince me that this is strictly correct, and that while it is possible to make an examination with an abnormally thick style point, this would not properly represent the conditions in practice. Not only have I made examinations under the microscope with normal styles, but I have also made such examinations with more pointed styles formed of needle points, and of such sizes that I knew, as a matter of absolute fact, that they did not fill the groove so as to simultaneously rest upon the side walls. Even under these conditions, it was practically impossible with such examinations as pointed out by Mr. Cameron to determine the question of contact between the style and the sides of the groove, because of the reasons which I have stated. Under Mr. Cameron's reasoning, he would assert that even these finer points were in absolute contact with the side walls when, as a mathematical proposition, they could not have been. I have prepared some drawings showing the results of my examination and am prepared to say that even under the most favorable consideration of the subject, from the complainant's standpoint, that these drawings correctly represent the actual conditions in normal operation of the defendants' apparatus which exist between the style point and groove. The first of these drawings is marked "Defendants' Exhibit, No. 43" and shows two figures marked Figs. 1 and 2. Fig. 1 shows the cross section of the groove in the tablet A and the style point B is shown in solid lines down to the points F G F and in dotted lines below that point, the dotted line portion C representing the original outline of the style point when first placed in the machine. For the sake of giving to the complainants every advantage it will be observed that this point is made to conform solidly with the bottom of the groove and slightly up the side walls thereof, gradually separating from said walls, this being an essential construction to enable the point of the style to reach the bottom. This is the position if the machine does not move. The moment, however, that the record tablet is moved under

the style, the point rapidly wears away, and if the groove is absolutely straight; that is to say, entirely devoid of lateral undulations, and, therefore, incapable of producing sounds, the extreme point of the style will wear down at once to the dotted line D D, and will exactly fit the bottom and side walls of the groove. This, however, is an abnormal condition, as it is unreasonable to presume that the grooves were ever made for such a purpose. However, for the purposes of the examination we will assume that the point was worn away so as to make it absolutely fit the groove on bottom and sides, and that then the groove was provided with lateral undulations which were rapidly brought under the style. These lateral undulations would vibrate the style point first to one side and then to the other, thereby making the style assume oblique positions corresponding to the dotted lines X and Y of Fig. 1. This is absolutely essential to make the diaphragm vibrate, and is at the bottom of the entire reproduction of sound. Assuming that the style has its centre thrown to the oblique position X it is evident that the right hand side walls of the record groove will wear away the metal of the style point between the dotted lines D and the solid line E. The vibration of the style in the opposite direction corresponds to the dotted line y will likewise induce the wearing away of the style between the dotted line D and the solid line E at the left hand side. Of course, this wearing away during the vibration, takes place gradually, but, nevertheless, begins at once upon reaching the lateral undulations of the groove, and enlarges itself continuously. The result of this operation produces the bottom of the style in conformity with the lines F G E F which is no longer of such a configuration as to accurately fit to the side walls of the groove. When the style is thus worn, and which is its natural condition, in the operation of the machine, the style will then bear the relation to the groove indicated in Fig. 2. In this case, the tongue G fits down to the bottom of the groove, and when the style is inclined in the act of vibrating the diaphragm, one side of this

tongue fits against the one side wall of the groove, but the other side of the tongue and other side wall of the groove are separated, as indicated at I in Fig. 2, and this separation is absolutely essential to permit the rocking motions of the style which are necessary to vibrate the diaphragm, and no matter how minute the said separation may be it demonstrates beyond the smallest question of doubt that in the normal operation of the apparatus the style does not simultaneously bear upon both side walls, as stated by Mr. Cameron, and under no conditions would it be reasonable to assume that it did rest upon both side walls, as such a presumption is totally incompatible with the true theory and intended purposes of the apparatus. The formation of the tongue G is such that it is of less sectional area than the area of the groove, the difference being illustrated between the dotted lines D and the solid lines E of Fig. 1. It is evident that by examining Fig. 1 that if the central line X of the style were tilted into a vertical position coincident with the vertical line to the groove, both sides of the tongue G would be clear of the side walls of the groove A. This is the condition at every time that the reverse tilting movement of the style takes place due to its vibration, and, consequently, for every complete cycle of the laterally undulating groove there are four times when the sides of the tongue of the style or its point are out of actual contact with the sides. At no time in the proper operation of the apparatus are both sides of the tongue in contact with both side walls.

When the style tilts it causes the under cut produced by the action of the side walls upon the lower part of the style to produce the overhanging shoulders F F, and these shoulders are so pronounced that they rest upon the upper surface of the tablet at H H. When the style is vertical these shoulders are not in contact with the upper surface of the tablet, but during the vibrations of the style the shoulders come alternately in contact with the upper surface on opposite sides of the groove, and largely sustain the downward pressure on the style, as I have before pointed out. In addi-

tion to the shoulders sustaining the downward pressure, the tongue G also rubs upon the bottom of the groove and aids in supporting the load, but the action of the shoulders F, owing to their much greater surface in the direction of the travel of the style, undoubtedly takes a very material part of the weight allowing the extreme lower part of the tongue to be ground away just so that it plays nicely in the bottom of the groove, and always maintains a shape which will enable it to act as a rocker during the interim in the actions of the shoulders and while the style is in the act of rocking from one oblique position across the vertical line to the other oblique position. The dotted line E' represents the same style worn down to a greater extent and showing the shoulders more pronounced, and is in strict conformity with what I have found to take place in actual practice. While these changes of shape and the extent of grinding indicated in the drawing seem to be very large, they are, as a matter of fact, exceeding small, but the drawings are made on such an enormously large scale that due consideration must be made on this account.

Another drawing which I have made as further illustration of this construction, is marked as an exhibit in this case as "Defendants' Exhibit, No. 44." In this drawing Fig. 3 shows a longitudinal section through the tablet and groove and the style point in elevation. The centre line is here shown as inclined, corresponding to the trailing inclination of the style in the machine. B is the style, G is the tongue, E is the flattened sides of the tongue, and F is the shoulder at the top of the tongue. The dotted line below the bottom of the groove indicates the extreme point of the style which has been ground off by contact with the groove. It will be seen that the tongue is of considerably greater length than height, and, consequently, therefore, the shoulders F are very pronounced and extended in area so as to be capable of sustaining considerable downward pressure without excessive wear, as compared with what would take place on the extreme bottom of the tongue G, which is not only of less length, but,

being on a curve, presents at times only a small surface of contact with the bottom of the groove, and is thus apt to wear away rapidly.

I have observed in some cases, more particularly those in which the style was perhaps harder than is usually the case, or also, perhaps, due to the material of the record tablet being slightly less brittle than in other cases, the bottom part of the tongue G ground into the bottom of the groove a shallow channel indicated at P in Fig. 5, and this shallow channel did not retain the central position in the bottom of the groove, but was caused to be formed slightly to one side or the other under the tilting or vibrating action of the style. This was an additional evidence of the fact that the style did not retain contact with both side walls simultaneously.

Fig. 4, of Exhibit No. 44, is a plan view of a portion of one of the record grooves of the defendants' tablet, and the shaded portions thereon are those portions where excessive wear are placed upon the groove and tablet by the style, both by its tongue G and its shoulder F. In this Fig. 4 the arrow indicates the direction of travel of the tablet. R is the central line of the bottom of the record groove A. S is the central line of the additional groove formed in the bottom of the main groove by the extreme bottom portion of the tongue G of the style. It also represents the line of travel of the bottom edge and middle portion of said tongue, and is in strict accordance with what I have stated. The displacement between the lines S and R is, of course, very minute, and this is as it should be, because they are approximately at the point of oscillation of the style or its place of least lateral movement within the groove. All portions of the style above the bottom move to a greater extent laterally and greater as we leave the bottom of the tongue. Where the groove is laterally undulating, as indicated in Fig. 4, we may assume the existence of an imaginary line which will cut across the various curves, and said line may be taken as the line in

which the fulcrum of the style upon the reproducer head travels. The curves of the groove operating on the point of the style oscillates it to one side or the other of this imaginary line, causing it to take the oblique positions indicated at x and y of Fig. 1, "Defendants' Exhibit. No. 43," and causes the opposite sides of the tongue G to be alternately acted upon by the opposite sides of the groove, and especially those portions adjacent to the places of maximum curvature in the groove. It also causes the shoulders F of the style to be received upon the upper surface of the tablet, on each side of the grooves alternately, as at J K L M in succession. One shoulder pressing upon the upper surface J of the tablet, on the right hand side of the groove A, and the other shoulder of the style next being caused to press upon the upper surface of the tablet at K, on the opposite side of the groove, and so on alternately at L and M. The sinuositities of the groove operate upon the lateral surface of the tongue of the style, first on one side and then on the other, alternately, and these actions correspond with the actions of the shoulders F on the upper surface of the tablet. When the lateral undulations of the groove in its side walls operates upon the lateral face of the style, or its tongue, it acts against a resistance to movement of the style, and, consequently, the point of the style hugs the side wall, which is directly in action more closely than the opposite side wall, as is clearly illustrated in Fig. 2 of Exhibit, No. 42. This also causes the bottom of the tongue of the style to be displaced from the central line of the groove to the position indicated by the dotted line S. Whenever the shoulder F is in full operation on the top of the tablet, the wear upon the tongue G becomes lessened, and this is always the case where the tongue is being acted upon by the sharp bends in the groove, as indicated at the shaded portions in the groove, Fig. 4, of Exhibit, No. 44. In those portions between places of extreme movement the shoulders F of the style are not materially supported by the upper surface of the tablet, and, consequently, a heavier duty is placed upon the bottom of

the tongue, and these places are indicated where the dotted line S crosses the solid line R, in Fig. 4, said positions being those assumed by the style when in its practically vertical position, or between the extremes of its lateral vibrations. Under the microscope the wear on the several parts is very clearly disclosed, and establishes the truth of the statements which I have made in this answer, and endeavored to illustrate by the diagrams.

In conclusion, therefore, I have no hesitancy whatever in stating that in the normal operation of the defendants' apparatus, and during the reproduction of sound, the style point is not simultaneously supported during the travel of the tablet by both side walls of the groove, but, on the other hand, the weight of the reproducer is sustained by the bottom of the groove and by the upper surface of the tablet outside of the groove, and the point or tongue of the style is operated upon alternately by the two side walls of the laterally undulating groove. The operation of the style in the record groove of the defendants' apparatus, is, therefore, in my opinion, radically different from the mode of operation required by the reproducing apparatus of the Bell and Tainter patent.

Counsel for defendants offers in evidence the two drawings produced by the witness and the same are marked respectively, "Defendants' Exhibit, No. 43" and "Defendants' Exhibit, No. 44."

Q. 26. You have frequently referred to the lateral capacity for adjustment of the reproducer style or reproducer, in the Bell and Tainter device to be such that it approximately should have a movement approximating the width of a groove with perhaps enough movement on each side of such requirement as to insure, mechanically, said adjustment equal to the width of a groove or approximately one one-hundredth part of an inch. Do you mean to say that the record tablet having vertically undulating grooves would not induce the feeding of the style transversely over its surface to a greater extent than the width of a groove?

A. In considering the question of the adjustment or capacity for adjustment of the style to the groove in the Bell and Tainter apparatus, I was considering the apparatus as described and of the necessities of the apparatus described. I have stated that the particular apparatus illustrated in the Bell and Tainter patent is such that without the external mechanical feeding mechanism it would be an absolute impossibility to rely upon the universal mounting of the style or the reproducer head itself and the record tablet to cause the reproducer to be fed transversely across the series of grooves of the tablet, and thereby dispense with the external mechanical feeding devices. I have referred to the tests made on the graphophone instrument showing that not more than the width of one and a half to two grooves could be relied upon as the possible automatic adjustment of the reproducer style, even on this improved machine. I do not wish to be understood as saying that a machine could not be produced in which a reproducer might be made to travel across the record grooves under the feeding action of the grooves themselves, but I do say that any such machine as might be so produced would not be the machine of the Bell and Tainter patent, and would involve material changes and new organization of parts to give it any such capacity. I am aware that the Graphophone Company have recently placed upon the market a small toy machine, with an endeavor to embody in its construction, on a miniature scale, some of the general features involved in the gramophone, but this machine is a mere toy, giving no satisfactory results, and being totally unfit for any purpose other than mere childish amusement. Furthermore, the duration of the tablet is very short and the machine, in every way, unsatisfactory, both in operation and the results produced. It is a toy and nothing more.

Sworn and subscribed to
before me, this sixth day
of March, 1901.

PHILADELPHIA, April, 24, 1901.

Met pursuant to agreement, at the office of Horace Pettit, Esq., 604 Stephen Girard Building, Philadelphia, April 24, 1901, at 10.30 A. M., for the purpose of cross-examination of Mr. Hunter.

Parties present: PHILIP MAURO, Esq., of Counsel for Complainant.

HORACE PETTIT, of Counsel for Defendant.

CROSS-EXAMINATION.

By MR. MAURO :

X Q. 27. You have stated that when the phonograph first came before the public you took every occasion to familiarize yourself with the same. To what year do you refer?

A. It was along in the latter part of the seventies, possibly as early as '77 or '78.

X Q. 28. Please state what experience you have with the Edison tin foil phonograph as it existed in 1878, or thereabouts.

A. My experience was with regard to the use of the instruments in the hands of others who exhibited them in operation. I frequently had occasion to carefully note the working of the instruments, and also had many of the records in my possession, which I carefully examined, as I was much interested in the subject.

X Q. 29. Did you acquaint yourself at that time with the construction of the instrument, and particularly with the manner in which the reproducer was supported and manipulated?

A. I am not very positive as to the actual mechanical constructions in the first machine which I saw, regarding the particular manner of supporting the reproducer, but my recollection is that in those machines the reproducer was carried on a frame, or arm, which was pivoted and clamped in position when brought up to cylinder carrying the tin foil.

× Q. 30. Do you recall that the reproducer diaphragm was carried upon an upright arm pivoted to the base of the machine, and provided with screws for adjusting and clamping it in position radially of the mandrel, and with other screws for adjusting and clamping it longitudinally of the mandrel?

A. I do not recall any screws for adjusting it longitudinally of the mandrel in these earliest types of machines, but my recollection is that they had provision for adjusting and clamping the arm radially of the mandrel.

× Q. 31. How long is it since you have seen an Edison tin foil phonograph?

A. Within a few months.

× Q. 32. After 1878, when was your attention next directed to the talking machine art by reason of any development therein?

A. I could not fix any definite date, but took notice of everything that came to my knowledge from time to time, and my recollection is that there was quite a little time which passed between the earlier Edison machines and the development of the phonograph for public use and sale.

× Q. 33. Did anything in the nature of a talking machine come to your attention between 1878 and 1886, and if so, what was it?

A. I do not recall anything special until the more perfected types of phonographs came upon the market, or were discussed with a view of their introduction in the market, and if I remember rightly, my attention was more particularly directed to the matter in view of certain controversies which seemed to arise about the time of the issuing of the Bell and Tainter patent, regarding the question of inventorship of the particular improvements which were then thought to be best adapted for use in a commercial machine.

× Q. 34. Between whom did the controversy to which you have referred arise, and what did they involve?

A. My recollection is that they were more particularly between Edison and Bell and Tainter. I do not refer to legal controversy, but more to opinions as to the claims of

these parties with regard to the right to be considered as inventors of the essential features of the talking machine, more particularly in connection with the use of engraved wax records.

×Q. 35. When did you first see a machine which made sound records by the process of engraving on a wax-like material?

A. I really could not say as I have no way of fixing upon my mind.

×Q. 36. Can you state whether it was before or after 1886?

A. It was possibly after that time, though, as I have made some inventions of my own, in about 1887, in phonographs, it is possible that it may have been a little earlier, but I am not prepared to fix any definite date on this point.

×Q. 37. Have you taken out any patents for improvements in talking machines?

A. Not on my own inventions.

×Q. 38. Are you interested personally or professionally with any concern or individual engaged in the talking machine business?

A. No, not to any extent whatever.

×Q. 39. Are you familiar with the various constructions of talking machines that have appeared on the market from time to time, since 1886?

A. I should say that I am.

×Q. 40. Do you know of any type of talking machine that has appeared on the market since 1886, in which the reproducer was not mounted on a universal joint and capable of automatic adjustment laterally and towards and away from the surface of the record tablet?

Objected to as irrelevant and immaterial, and not proper cross-examination.

A. I understand this question to refer to the so-called automatic adjustment of the reproducer upon the supporting arm and relatively to the record tablet while the said arm is mechanically propelled by an external feeding mechanism

for the purpose of positively carrying the reproducer across the record groove of the record tablet. With this understanding I would say that I do not recall at this time any phonograph machine which went into commercial use but what embodied these features.

In giving this answer, I have wholly excluded any consideration of the gramophone as that machine works on an entirely different principle.

× Q. 41. What is there in my last question No. 40, which you think justifies the assumption that I referred to talking machines having a particular kind of feed mechanism?

A. In the first place the question followed the previous question relating to wax record machines and in the next place, the language of Q. 40, refers to the automatic adjustment, and I understand that this automatic adjustment is one which is to compensate for what would otherwise be a defect due to the mechanical construction of the machine more particularly on account of the nature of the external feeding mechanism employed in machines used in connection with wax records. Moreover, the question has reference to the automatic adjustment capacity of the "reproducer," and I therefore assume that the language of the question refers to the automatic capacity of adjustment of the reproducer, *per se*, upon its supporting arm or carrier, whereby the reproducer may compensate as to position of its style in the record groove to obviate the defects which would be introduced by the mechanical feeding of the carrier or supporting arm. These are constructions which are not employed in the gramophone, and, for these reasons, I have excluded the gramophone in giving my answer to × Q. 40.

× Q. 42. Is it your understanding then that the words "automatic adjustment" necessarily imply a feed mechanism of a particular description?

A. No, not at all, but it does imply that there is a mechanical feeding mechanism of some character for posi-

tively and uniformly feeding the reproducer arm or carrier longitudinally of the record.

× Q. 43. Now, please state whether or not it is a fact, so far as you know, that every talking machine now on the market, whatever feeding means it may employ, has its reproducer mounted on a universal joint and its style resting on the record tablet by gravity. If you are aware of any talking machine now on the market which does not have these features, please specify it.

A. No, it is not a fact. The language of the question specifies the construction of machines such as employed in the graphophone and phonograph, but it does not describe the class of machine embodied in the gramophone, because, in the gramophone the reproducer *per se* is not mounted upon its carrier on a universal joint. It is rigidly mounted upon its carrier and the more rigidly the better. The carrier itself, at a great distance from the reproducer, is mounted on a universal joint such as employed in the old Edison machines disclosed in the Edison English patent of 1878, but this is a construction very different from the graphophone or phonograph and not within the language of the question.

× Q. 44. It is your testimony then, as an expert in this case, that in the gramophone as represented by "Complainants' Exhibit, Defendants' Machine" the reproducer is not mounted on a universal joint. Am I stating your views correctly?

A. You are because the reproducer *per se* is mounted rigidly upon its carrier.

× Q. 45. Please explain to the Court the distinction you make between the "reproducer" and the "reproducer *per se*," if any.

A. I make no distinction, but I use the words "reproducer *per se*" to emphasize my understanding of the statement in the question that the reproducer is universally mounted.

The question unquestionably is intended to include the

construction of machines set out in the Bell and Tainter patent wherein the "reproducer *per se*" is universally mounted upon the carrier, and I, therefore, am giving to the question the common-sense meaning that it should have. I do not consider the carrier of the reproducer and the reproducer itself as one and the same thing.

X Q. 46. In the graphophone the reproducer, that is to say, the diaphragm and its actuating stylus, are supported by an arm mounted at its end remote from the diaphragm on a universal joint. Is that correct?

A. The language is misleading. The reproducer embodies not only the diaphragm and style, but also the immediate supporting castings or metal parts which are positively and rigidly secured to these portions. In the graphophone the sound box has an opening extending to one side in the form of a short tube somewhat similar to the Bell and Tainter patent in suit, and this short tube is connected by a universal joint with a tubular part on the carrier which is mechanically fed across the record tablet. There is, therefore, no arm in the sense in which I have used the word "supporting or carrier arm" for the reproducer. In the graphophone this short tubular neck is properly considered as part of the reproducer, as it is an integral part of it. This is not so in the gramophone as the reproducer in that instrument is wholly distinct from the carrier arm and is detachably connected to it, but is held against adjustment upon it when in attached position. In the gramophone, the carrier arm is in no sense a part of the reproducer.

X Q. 47. In the gramophone, as represented by "Complainant's Exhibit, Defendant's Machine," is the reproducer carried by an arm mounted on a universal joint at the end remote from the reproducer?

A. It is attached to such an arm, but it is not carried by said arm in operation, but rather the reproducer carries the arm at the free end. I would further point out that the arm does not feed the reproducer across the record tablet but, on the other hand, the said arm simply acts as a radius bar for

holding the reproducer in an upright position. No automatic adjustment is at all required for the reproducer in the gramophone, because the style of the reproducer being once placed in the groove always remains in that groove and cannot get out of it. Consequently, such an idea as an automatic adjustment by supporting the reproducer *per se* on a universal joint upon its carrier does not enter into the construction of the gramophone, while it is an essential and necessary part of the graphophone.

All after the first sentence of the foregoing answer is objected to by complainant's counsel as irresponsible and volunteered.

× Q. 48. You say that the reproducer carries the arm at the free end; that is, because the reproducer rests by gravity on the record tablet, is it not?

A. It is.

× Q. 49. In the graphophone, does the short tube which you say is properly a part of the reproducer, support the diaphragm and stylus?

A. It does, because it is an integral construction with it. They are all part of the same reproducer construction, and, therefore, co-act to support one another.

× Q. 50. But in operation, and strictly speaking, the stylus and diaphragm support this tubular arm, do they not?

A. In a sense they support it, but I do not call it an arm. It is simply a tubular extension forming an integral part of the reproducer, and which must of necessity be connected with the external mechanically operated feeding carrier. The reproducer in the graphophone is a very light affair, so that the idea of supporting any weight does not enter into consideration. The support of such weight as is placed upon the style of the gramophone would instantly destroy the record of the graphophone.

All after the second sentence is objected to by complainant's counsel as irresponsible and volunteered.

× Q. 51. In preparing and giving your deposition in

this case you have consulted depositions given in other suits brought upon Patent No. 341,214, have you not?

A. I have.

X Q. 52. What records have you consulted in this connection, and what depositions?

A. American Graphophone Co. v. Leeds and Baldwin, American Graphophone Co. v. National Gramophone Co. and Frank Seaman, and more particularly the depositions of Benjamin in the Leeds case, and the deposition of Joseph Lyons in the National Gramophone case.

X Q. 53. I suppose it was from these depositions that you obtained the prior patents and publications to which you have referred, and if you have introduced any prior patents or publications not referred to in one or the other of these two cases, please specify it or them.

Objected to by defendants' counsel as incompetent and not proper cross-examination, and further objected on the ground that the exhibits in this case have been offered in evidence by counsel for defendant, and where he obtained the same it is not shown that the witness has knowledge.

A. I would refer to "Defendants' Exhibits, No. 34," Dana and Silliman, "American Journal of Science," and No. 41, being Bell's Researches in Electric Telephony. Also, No. 33, extract from article entitled, "The Examination of Vowel Sounds."

Recess until 1.30.

X Q. 54. In the first part of your deposition, you discussed the process of making sound records by engraving, which is described and claimed in patent 341,214, in suit, and I understand it to be your opinion that that process and the engraved sound record produced by it, was not new with Bell and Tainter, but was in possession of the public prior to the date of said patent. Is that your opinion?

A. No. My opinion was that while the broad idea of engraving a wax record was not new with Bell and Tainter,

it is quite possible that there was some novelty in the particular manner in which they engraved their record groove, so as to produce a record surface made up of a series of shallow grooves and practically sharp ridges between the grooves, so that at any place on the surface of the record, the style would have a tendency to slide down the sloping side walls from such a ridge into the bottom of the groove, if it were accidentally placed upon such ridge, or upon the walls of the groove adjacent to the ridge.

× Q. 55. Do you or not wish it to be understood as your opinion, that the engraved sound record broadly was in public use or knowledge prior to the date of patent 341,214, in suit? And I refer particularly to that part of your deposition where you quote from Edison's British Patent 1644, of 1878, with reference to the use of a sheet of paper coated with paraffin or other hydro-carbons, waxes, gums or lacs?

A. I wish to be understood that in my opinion the broad idea of engraving a wax record was a public knowledge prior to the date of the Bell and Tainter patent referred to.

× Q. 56. In this part of your deposition, to what extent did you avail yourself of, or utilize the deposition of Mr. Benjamin, defendants' expert in the Leeds and Baldwin case?

A. In little or no matter, that I recall.

× Q. 57. Have you, prior to your giving your opinion in this case, acquainted yourself with the opinion of Judge SHIPMAN in the Leeds case, as to the bearing of the matter, which you quote from the Edison British patent, upon the novelty of the engraved sound record?

A. I have read that opinion prior to giving my deposition.

× Q. 58. In your deposition, particularly in that part which relates to Claims 19 to 23, inclusive, of the patent 341,214, you followed very closely the deposition of Mr. Lyons in the suit against the National Gramophone Co. and Frank Seaman, did you not?

A. I did, to a very material extent.

XQ. 59. You not only adopted Mr. Lyons' views, but to the extent of a great many pages you adopted the very language of Mr. Lyons, did you not?

A. I did so as to make the consideration of certain points agree exactly in this case and that against the National Gramophone Co. and Frank Seaman.

XQ. 60. In some instances, where you put in in bulk whole paragraphs and pages of Mr. Lyons' deposition, you changed a few words at the beginning or at the end of the paragraph. Why did you do this, if you have any reason therefor?

A. I had no reason except that in some instances I preferred my own manner of dealing with the subject, and quoting his language where I thought that it was advisable. There was no special object in any of those changes which you refer to.

XQ. 61. You speak of quoting Mr. Lyons' language. Did you put any part of the matter taken from his deposition into quotation marks or give him the credit of authorship in any way?

A. I did. This was not at all necessary in those parts of the deposition where I was giving my own opinion as those opinions were the same whether I adopted the simplicity, the language of Mr. Lyons in whole or in part or not. The object was largely to facilitate getting the record completed, as the treatment of this case necessarily required to be similar to that in the National Gramophone Co. case since the questions involved were identical.

XQ. 62. How do you know that this case required similar treatment to that of the National Gramophone Co., by whom was it required, and what has that got to do with the giving of your individual opinions upon questions of expert character in a case?

A. The questions involved in the two cases are the same. It is, therefore, self-evident that counsel for the defense would naturally handle the two cases in substantially the same manner. My testimony was given without any regard to the

opinions of Mr. Lyons and it is totally immaterial whether, for the reasons already explained, I adopted his language in those particular portions of his deposition where my opinion was so identical with his own that there was no possible question as to the similarity of our understandings. My opinion is the same, whether I use the same language of Mr. Lyons, or use special language of my own. You will find a very great portion of my deposition treating of the subjects here involved entirely from my own standpoint, and where I have not adopted the language of Mr. Lyons.

× Q. 63. For example, Mr. Lyons says, "So far as the cutting or engraving of a sound record is concerned, Messrs. Bell and Tainter are probably the pioneers." You do not agree with Mr. Lyons in that statement, do you?

A. Most certainly not, and this is an example of where my independent opinion will be found defined in my own language.

× Q. 64. Do you consider Mr. Lyons a person well versed in the theory and history of the art and history of reproducing sound?

A. I know nothing about Mr. Lyons' ability in this direction other than is found in his testimony, as evidenced by that testimony.

× Q. 65. Do you know anything of the attainments of Mr. Emile Berliner as an expert in the art of recording and reproducing sounds?

A. I know of his work by reputation and by his own statements regarding the work which he had performed in the development of the gramophone, but I was not in anywise associated with him during any of his experiments. I have had personal knowledge of some of his early work, and I would recognize Mr. Berliner as a man who had made material and important developments in reproduction of speech on the particular lines carried out in the commercial gramophone.

× Q. 66. Did you in your preparatory work in this case

read the deposition of Mr. Emile Berliner given in the American Graphophone Co. v. Edison Phonograph Works?

A. No.

X Q. 67. In that deposition Mr. Berliner says :

"Since the exhibition of the Edison Phonograph in 1878, no advance of any consequence had been made in the art of recording and reproducing sounds. The subject had apparently dropped out of the notice of scientific men and of the public generally, the phonograph having failed to realize the expectations which it created. The issue of the patents to Bell and Tainter, however, and the methods and apparatus which they described gave a new impetus to the art, and amply demonstrated that the problem of recording and reproducing sounds with sufficient accuracy and certainty to subserve actual commercial needs and had been solved." How do those statements accord with your knowledge and information touching the history of this art?

Objected to as incompetent, irrelevant and immaterial, and not proper cross-examination, and that the deposition quoted from is not a deposition or of record in this case.

A. My answer to this question would depend very much upon the meaning given to the particular words used in the quotation. I can only say, as I have before intimated, that the issuing of the Bell and Tainter patent did introduce certain controversies with regard to their work and that of Edison, and in view of their claims as to what they had and could accomplish, they did, undoubtedly, give a new impetus to this old art, and induced Edison to actively take up his former work and continue in the lines which he had worked on prior to Bell and Tainter's invention. The work of these parties unquestionably induced the production of commercial phonographs, but this might have taken place without conceding any special novelty in the wax records of the Bell and Tainter patent. The feature, however, of a wax record having very shallow grooves and with clearly defined

ridges between them, combined with a reproducer universally supported upon its carrier which latter is mechanically and positively fed by an external feeding mechanism, did open the field for an advance in the phonograph of that character. This, however, was on entirely different lines from that in which Berliner was working.

X Q. 68. Mr. Hunter, you are a patent lawyer and solicitor, are you not?

A. I am not a patent lawyer, but am a solicitor of patents and have been for thirty years. I have devoted my attention very largely for more than twenty years to expert work.

X Q. 69. You have often taken the depositions of witnesses to be used in patent cases, have you not?

A. I have.

X Q. 70. And you know what is, and what is not responsive to a question?

A. I do.

X Q. 71. Now will you please look at Q. 67 and tell me what there is in it which calls for an expression of your views as to any supposed differences between Mr. Berliner's work and the work of Bell and Tainter?

Same objection as to Q. 67.

A. X Q. 67 was a quotation from the language of Mr. Berliner, and as it was only a very small portion of the deposition, there would be drawn from the question the implication that Berliner meant to say that the whole art of phonography was made commercially a success by the issuing of the Bell and Tainter Patent. I do not believe that he meant any such thing. While I cannot say with absolute certainty what he did mean by that language, I cannot answer categorically. I, therefore, expressed my opinion as to my understanding of what would be meant by that language, and to prevent any possible misunderstanding on the subject, and to prevent any unreasonable implications to be drawn from the question, I added at the end of my answer the statement that the development pointed out in the patents of Bell

and Tainter and referred to by Berliner, was on a different line than that in which Berliner was working in the production of the gramophone, and I believe that this statement under the circumstances is a proper statement to be made in my answer.

× Q. 72. Your answer to Q. 67, then, gives your idea of the fair interpretation of the quotation from Mr. Berliner, does it?

A. I think it does.

× Q. 73. That being true, I will read you a little further from Mr. Berliner: "Between the phonograph and the graphophone, apart from many important differences of detail, I recognize three fundamental distinctions:

"*First.* In the recording instrument, which in the one case is an indenting point, and in the other a cutting or graving tool.

"*Second.* In the method of forming a record, which in the one case is accomplished by denting or bending a pliable substance by contact with the surface thereof, and in the other by cutting or engraving with a graver or cutting tool, whose point is constantly imbedded in the hard material (such as wax) of which the surface of the recording tablet is composed, and

"*Third.* In the record itself, which in the one case is a soft, pliable strip, the faint indentations of which are easily obliterated, and in the other a hard, resisting tube or disc, having grooves cut or engraved in its surface.

"The graphophonic method and apparatus were first made public by the issue of the letters patent above referred to on May 4, 1886, and the method and apparatus disclosed in said patents were at the time entire novelties to the public and to scientific men. My familiarity with the history of this art, and with what had recently been done and written, enables me to say with confidence that the method of forming a record by engraving in solid materials in general, and waxy compositions in particular, the use of a graving style, the production of a record consisting of a solid body cut or

engraved with narrow grooves of varied form corresponding to sound waves, and other features of the graphophone, as set forth and claimed in the above patent, were not known prior to the invention thereof by the patentees, and are not described, shown or suggested in any patent or publications prior to the date of said patents."

How do these statements of Mr. Berliner accord with your views on the matters referred to by him?

Objected to, as incompetent, irrelevant and immaterial, and not proper cross-examination, and further, on the ground that the deposition quoted from is not a deposition or of record in this case. Counsel for defendant hereby protests against this method, adopted by counsel for complainant, of spreading upon this record a portion of the deposition taken on behalf of complainants', being one of complainant's witnesses in the suit of the American Graphophone Company v. Edison Phonograph Works, and gives notice that motion will be made upon the hearing to expunge the portion of the deposition of complainant's witness quoted upon the record.

In reply, counsel for complainant merely calls attention to the fact that this very witness had repeatedly quoted in his deposition from depositions in other cases which are not in evidence here, and have not been offered in evidence by defendants' counsel.

A. I do not know that we disagree in our views, because the language quoted from Mr. Berliner's testimony is directed to a comparison of the Bell and Tainter invention of the patent in suit, with the old tin foil phonograph of Edison, which was the type of phonograph with which the public were acquainted. The distinctions, therefore, between the two machines, are perhaps correctly stated by Mr. Berliner. The latter portion of the quotation, when examined carefully, simply means that the details of the invention, both in the production of the engraved wax record and the special reproducing apparatus disclosed in the Bell and Tainter patent

were, as far as he was aware, new with those patentees, and was not described, shown or suggested in any patent or publication prior to the date of said patent. I agree with this language exactly, because I have clearly defined what was the nature of the engraved wax record and also the nature of the reproducing appliances to be used in connection with it, and I have always accorded to the Bell and Tainter patent the novelty of these features when properly defined. Berliner simply speaks of the feature of the graphophone "as set forth and claimed in the above patent" and it is simply a question as to what the inventions were that were set forth and claimed. I have defined or given my understanding as to what these inventions were which were novel with Bell and Tainter, and these features, as far as I am aware, "were not known prior to the invention thereof by the patentees, and are not described, shown or suggested in any patent or publication prior to the date of said patent," which latter statement is the exact language of Berliner quoted. The developments of the Bell and Tainter graphophone were simply compared by Berliner with the old tin foil Edison machine, and hence to a machine which had an external mechanical feeding device, and with this understanding he no doubt correctly stated that the Bell and Tainter improvements were material over that type of machine.

× Q. 74. You would infer, would you, that Mr. Berliner was not aware of Edison's British Patent No. 1644, of 1878, from which you quoted in your discussion of the novelty of the engraved sound record?

Objected to as incompetent, irrelevant and immaterial.

A: I do not make any such inference, as of course I do not know, but that would not alter the fact at all.

The Bell and Tainter special construction of wax records, as employed in the graphophone instruments, is not disclosed in the Edison or any other prior patents.

× Q. 75. Speaking of the early Edison phonograph and its method of operation, I observe that Mr. Berliner says:

"One of the earliest published descriptions is that contained in "The Scientific American," of Nov. 17, 1877, which describes the use of a paper strip having a V-shaped ridge in the summit of which the indentions were formed. Other publications and patents, notably British Patent No. 1644, of 1878, suggest paper saturated with paraffine and other substances; but all the publications descriptive of the instrument made and exhibited show that thin metal foil was settled upon as the material most suitable for receiving the indentations of the style."

If I understand your deposition, you found in this British patent, to which Mr. Berliner here refers, a disclosure broadly of a sound record engraved in a solid material, particularly in a material of wax-like nature. Have I correctly understood you?

Same objection and notice as to X Q. 73.

A. You have correctly understood me, and I want to say at this time that the statement by Mr. Berliner above quoted, is incorrect. Mr. Berliner says that the patent only discloses the idea of paper "saturated" with paraffine or wax. The language of the patent is very clear that the paper is "coated" with paraffine, etc., and there can be no question from the description in the patent itself that the coating is of material depth and in it the record grooves are formed without in any manner interfering with or disturbing the uniformity of the paper or card layer itself.

X Q. 76. And in this same patent, No. 1644, you find a disclosure broadly of the freely mounted reproducer of patent 341,214 as claimed in Claims 19 to 23 thereof, and by broadly, I mean if given such scope as to embrace the construction embodied in "Complainant's Ex. Defendants' Machine." Have I again correctly understood your views?

A. You have.

RE-DIRECT EXAMINATION.

By MR. PETTIT:

RDQ. 77. When you stated in answer to X Q. 53 that the three exhibits mentioned in that answer "Defendants' Ex-

hibits, Nos. 33, 34 and 41" were certain prior patents and publications in this case which were not in evidence in the cases of the American Graphophone Co. v. Leeds and Baldwin, and American Graphophone Co. v. National Gramophone Co. and Frank Seaman, did you mean to be understood that the record in this case was otherwise the same?

A. I did not.

RDQ. 78. In your answer to XQ. 61, when you stated that "the object was largely to facilitate to getting the record completed as the treatment of this case necessarily required to be similar to that in the National Gramophone Co. case since the questions were the same;" did you mean to be understood that your treatment of the subjects involved was the same as the treatment of the said subjects in the said National Gramophone Co. case referred to?

A. No, I did not. What I meant was this: The general questions involved being the same, and the general defenses being the same there was naturally a similarity of treatment, but my deposition has been given in a great many directions which treat of the matters here involved differently than they were treated in the deposition of the other case, the differences being due to my own opinions as set out in my deposition. I have not followed the deposition in the National Gramophone Co. case except in those portions were my views exactly coincided with the testimony of Mr. Lyons given in that case.

RDQ. 79. Do you mean to be understood that the only Defendant's Exhibits which have been introduced in this case and are not in the case against Leeds and Baldwin and in the case against the National Gramophone Co. are Defendants' Exhibits, Nos. 33, 34 and 41?

A. No, I did not, as there are quite a number of other exhibits. Those were special exhibits from prior printed publications.

Examination of Mr. Hunter closed.

(Signed) RUDOLPH M. HUNTER.

Counsel for defendants offers in evidence copy of opinion of Messrs. Pollok & Mauro *re* Berliner Patents which is marked "Defendants' Exhibit, Pollok & Mauro's Opinion."

Defendants close their proofs, of which fact notice is hereby given.

IN THE
CIRCUIT COURT OF THE UNITED STATES.
EASTERN DISTRICT OF PENNSYLVANIA.

—
IN EQUITY.
—

October Sessions, 1898. No. 34..

—
AMERICAN GRAPHOPHONE COMPANY,
v.
BERLINER GRAMOPHONE COMPANY, JOHNSON,
et al.
—

It is stipulated and agreed by and between counsel for the respective parties that the cross-examination of Defendants' Expert Rudolph M. Hunter, will be suspended until April 18, 1901, provided that the cross-examination by the complainant shall be concluded on April 19, 1901.

It is further stipulated and agreed that complainant's time for rebuttal testimony shall be extended twenty days from the date of conclusion of Mr. Hunter's deposition.

It is further understood and agreed that all stipulations entered of record, some of which were placed upon the record in the absence of complainant's counsel subject to his approval, are approved and agreed to by counsel for both parties.

PHILIP MAURO,
of Counsel for Complainant.
HORACE PETTIT,
of Counsel for Defendants

April, 1901.

CIRCUIT COURT OF THE UNITED STATES,
EASTERN DISTRICT OF NEW YORK.

American Graphophone Co.

vs.

In Equity/

Berliner Gramophone Co.,

Thomas S. Parvin, and

Eldridge R. Johnson.

MOTION TO LIMIT AND APPORTION TIME.

To HORACE PETTIT, Esq.,
Counsel for above-named defendants,

Dear Sir:-

Please take notice that on Monday, Dec. 31,
10 o'clock, A. M.
1900, at ~~the opening of the Court~~ on that day, or so soon
thereafter as Counsel can be heard, I shall move before
the Court in the Court Room thereof in the Post Office
Building in the City of Philadelphia, for an ORDER
limiting the time for both parties to this suit to
complete their testimony, ~~xxxxxx~~ to the three months
period provided by the Equity Rules, and apportioning
the times for the respective parties/. I shall refer to
the proceedings already in the case and the annexed affi-
davit/
Very respectfully,

Philip Mauro

Of Counsel for Complainant.

Service of the foregoing Notice and the annexed
affidavit acknowledged this *29th* day of December, 1900.

Edmund J. Davis
of counsel for def.

IN THE CIRCUIT COURT OF THE UNITED STATES
For the Eastern District of Pennsylvania.

AMERICAN GRAPHOPHONE CO.,

VS.

IN EQUITY.

BERLINER GRAMOPHONE CO.
THOMAS S. PARVIN, and
ELDRIDGE R. JOHNSON.

AFFIDAVIT IN SUPPORT OF MOTION.

STATE OF NEW YORK,
City and County of New York, SS.:

C. A. L. MASSIE, being first duly sworn, deposes and says: I reside in the City of New York and am of counsel for complainant herein and familiar with the complainant's recent litigation, including the present suit.

Complainant's principal patents here sued on were granted May 4, 1886, and therefore have only a little more than two years longer to run.

Some time during the latter part of the year 1898, complainant obtained a final decree in the Circuit Court of the United States for the Southern District of New York against Leeds & Baldwin holding that certain talking machines put out by the defendants in that case were infringements of complainant's patent No. 341,214 (one of the patents here sued on), and enjoining the said machines. This opinion was handed down by Judge SHIPMAN and is reported in 87 F.R. page 273.

The machines handled by the defendants in that case employed the swinging reproducer arm pivoted at some distance from the record. Relying on that prior adjudication complainant filed in Oct. 1898 a bill in Equity in the same Court charging that the so-called Gramophone talking machine was also an infringement. The parties who were made defendants were the National Gramophone Co. and Frank Seaman.

Complainant moved promptly for a preliminary injunction which was granted but afterwards set aside by the Court of Appeals on the ground that the prior adjudication relied on (the Leeds & Baldwin ^{case,} supra) was not sufficient to warrant the granting of a preliminary injunction.

Complainant proceeded to take its prima facie proofs. In the meantime it ^{had} transpired that the Gramophone talking machines which formed the subject of this New York suit, were manufactured by the Berliner Gramophone Co. and Thomas S. Parvin and Eldridge R. Johnson. Complainant thereupon filed the present bill of complaint in this Court making the three parties last named defendants thereto.

The New York suit was prosecuted diligently by complainant as already stated. Complainant's direct examination was completed March 29, 1899, and the defense was notified to cross-examine. Cross-examination was deferred at the request and for the convenience of counsel for the defense until May 30, 1899. The cross-examination was then continued from time to time at great length until September 22, 1899 when it was completed. Complainant's prima facie case was closed by formal entry on the record Oct. 12, 1899. Counsel for the defense then took a long expert deposition, beginning Dec. 26, 1899. The direct ~~exam~~ examination proceeded at the convenience of counsel for the defense and was completed April 23, 1900. There was a short cross-examination by complainant's counsel on July 25, 1900. Thereafter complainant's counsel repeatedly urged and insisted upon speeding this New York case to hearing, and was informed on several occasions by Messrs. Lyons and Bissing (who had been conducting the examination on behalf of the defense) that the case would be closed with their expert deposition, unless possibly they might desire to take one or two short

depositions on matters of fact. The case was regarded as practically closed so far as the taking of testimony was concerned, and it was confidently believed that the case would be ready for trial not later than the February term, 1901. About the middle of October, 1900, counsel for the defense notified complainant's counsel for the first time that it would then be impossible for the case to be ready for trial at the ensuing February term and that he could not give any assurance at all as to when proofs for the defense would be closed. Thereupon complainant noticed a motion to limit and apportion the time which was heard before his Honor, Judge LACOMBE on or about the 19th day of Oct. 1900. Judge LACOMBE granted an order requiring the defendants' proofs to be completed on or before December 18, 1900; and this order was afterwards modified by consent so that defendants might have until Jan. 8, 1901.

On or about Nov. 16, 1900, complainant was served with notice of petition in the New York suit, on behalf of the U. S. Gramophone Co. and Berliner Gramophone Co. (the last-named being one of the defendants herein) and the petition being signed by Thomas S. Parvin (another one of the defendants herein) as President of the said Berliner Gramophone Co., which petition set up, among other things, the fact that the defense in the New York suit had been conducted all along, under a certain written contract, by the petitioners, the U. S. Gramophone Co. and Berliner Gramophone Co. represented by Hon. Charles E. Mitchell, Hon. Howard W. Hayes, Gustav Bissing, Esq., and Horace Pettit, Esq. The moving papers annexed to the said petition clearly established the fact that the Gramophone talking machines, which formed the subject of the suit in New York, were manufactured and supplied to the defendants in that suit by

the defendants in this suit. The questions involved in the two suits are absolutely identical, viz: whether or not the Gramophone talking machine manufactured by the defendants herein (and sold by the defendants in the New York suit) are infringements of certain patent claims owned by complainant.

During the course of taking testimony in the New York suit both for complainant and for the defense, the gentlemen retained by the defendants herein as counsel for the defense in that suit, had absolute and entire charge of the defense; they decided ^{and how} when they would cross-examine complainant's witnesses, when ^{and how} they would examine their own witnesses ^{and where} and where, and when ^{and where} he should be cross-examined; in short, as already stated, they had absolute and entire control of the defense from beginning to end.

On Nov. 9, 1900, Mr. Pettit presented a motion in this present case "on behalf of defendants to limit complainant's time for putting in evidence its prima facie proofs to thirty days from the date of said motion and in default thereof the bill to be dismissed". When the motion came on to be heard, after some discussion participated in by his Honor JUDGE McPHERSON, it was decided that the motion should be withdrawn for the time being.

Subsequently, during the latter part of December, 1900, the petition already referred to herein was presented in the New York Court, and after argument an opinion was handed down upon which an order was based permitting the Gramophone Companies (one of whom is a defendant herein) to withdraw the appearance of counsel retained by them to defend that suit.

From the foregoing facts it appears that complainant can readily complete its prima facie case within a few days

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time, certainly within one week; that defendants can complete their testimony within a few weeks time, probably within less than one month.

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Subscribed and sworn to before me,

this 28th day of Decmeber, 1900.

Oliver S. Camp
Notary Public
N.Y.C.

IN THE CIRCUIT COURT OF THE UNITED STATES

Eastern District of Pennsylvania.

October Sessions, 1898, No. 34.

In Equity.

American Graphophone Company

vs.

Berliner Gramophone Company, Thomas S. Parvin and

E. R. Johnson.

Befne McPherson

This matter having come on to be heard on motion for decree in accordance with the annexed consent, it is on this 15th day of February, 1902, without costs to either party as against the other, ORDERED, ADJUDGED AND DECREED, as follows :-

That the claims in controversy of the patent in suit No. 341,214 granted May 4, 1886 to Chichester A. Bell and Sumner Tainter for improvements in Recording and Reproducing Speech, and other sounds and for apparatus therefor, are good and valid; that the complainant, the American Graphophone Company was, at the time of the filing of the bill of Complaint herein possessed of the full, entire right, title and interest in and to the said patent, and is entitled to sue for and recover

for said infringement ; that the defendants herein have infringed upon the said claims in controversy of the said Letters Patent by making or causing to be made, and using, or causing to be used, and selling, or causing to be sold, certain machines or apparatus for ~~xxxxxxx~~ Reproducing Speech, such talking machines being commonly known as gramophones.

And it being shown to the court that the complainant and the said defendants have made a settlement of all ~~claims for all damages, profits, costs and charges~~ whatsoever, and that the said defendants have duly paid said amounts, it is further ordered that this settlement shall include all claims for damages or profits which might be due to the complainant for infringement of the said Letters Patent in suit by all purchasers and users of machines purchased from the said defendants .

IT IS FURTHER ORDERED ADJUDGED AND DECREED that a perpetual injunction issue against the said defendants as to the said claims of the said patents.

By the Court

We hereby consent to the entry and filing of the above decree.

Thos. Shaw

Of Counsel for Complainant

John P. Pettis
Of Counsel for Defendant & *Shaw*

Feb. 15th 1902.